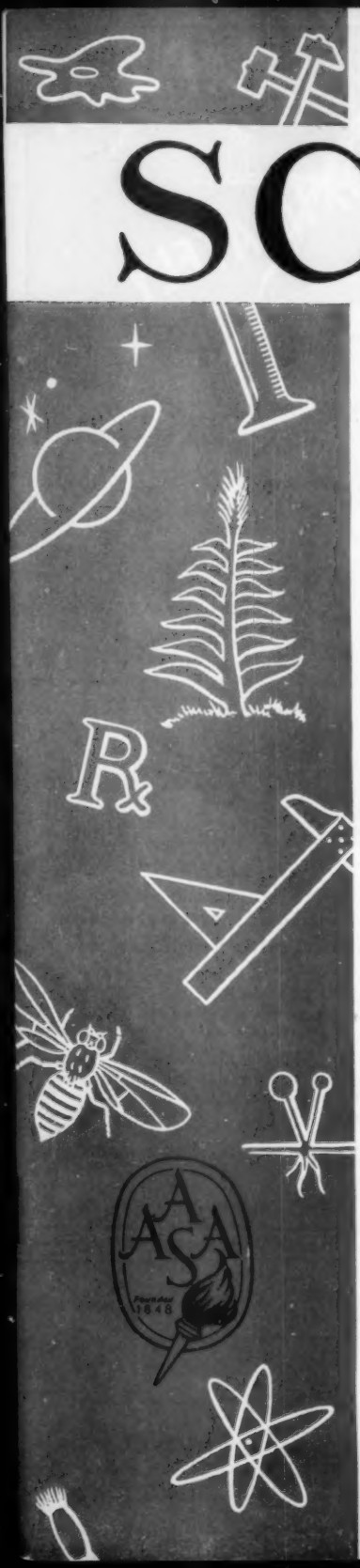

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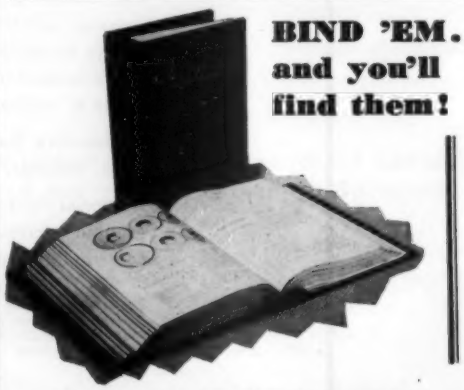

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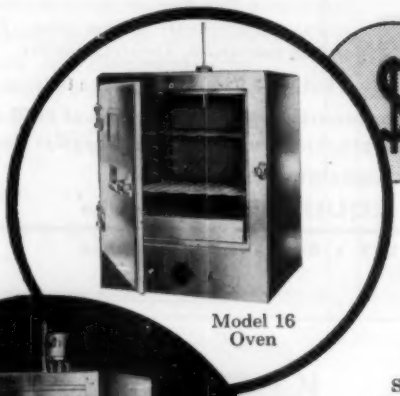

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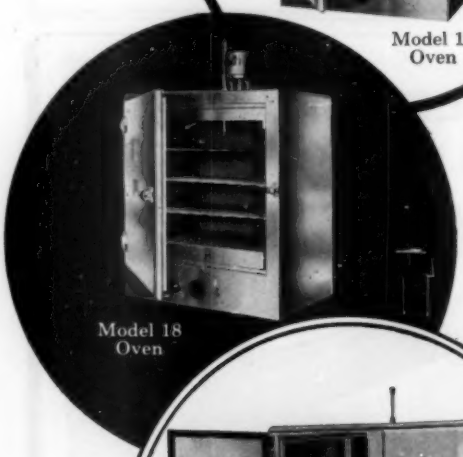

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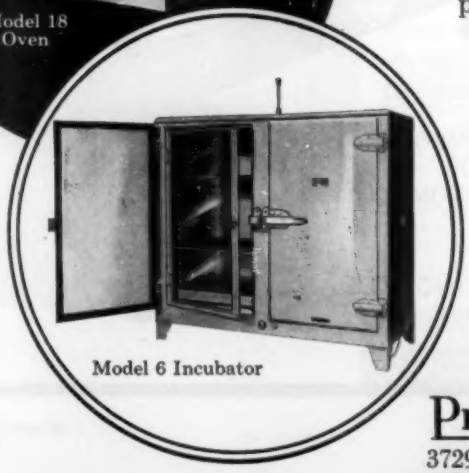

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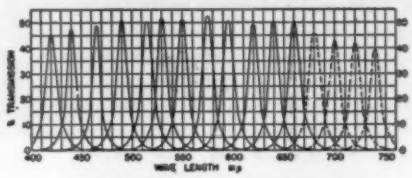

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2. R. S. Adams and C. E. Watson, *J. Biol. Chem.* **147**, 460 (1943).
3. Dicumarol is the trademark for. . . .
4. S. H. Aston, *An Introduction to Biochemistry* (Street & Smith, New York, ed. 3, 1948), p. 36.
5. White's determination of this factor involves. . . .

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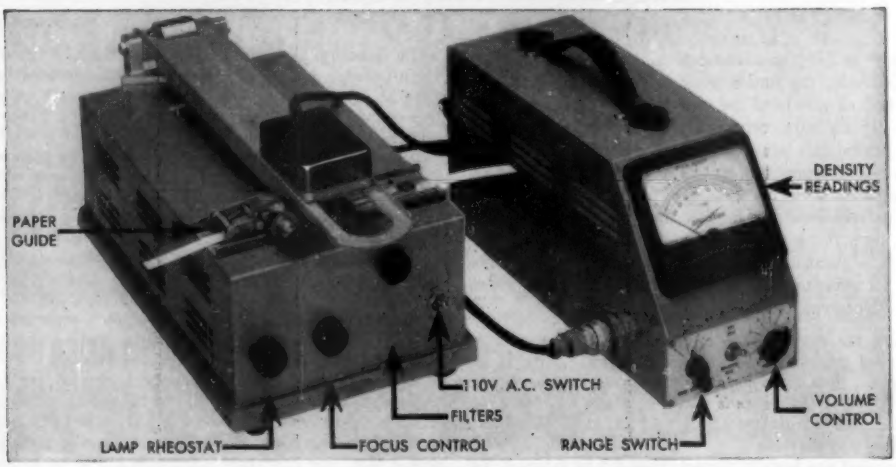

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Strengthening the Basis of National Security

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Those charged with safeguarding the United States have sought to minimize the danger of internal subversion through the screening of government employees and persons having access to classified information. This program is necessary, but it poses a serious dilemma: the more completely we succeed in reducing the danger that information now in our possession may leak to a potential enemy, the more risk we run of interfering with scientific progress and of reducing the technologic superiority and the moral and physical strength upon which victory in the ultimate test would depend. The inherent dangers of this dilemma can be lessened and our strength enhanced by changing our basic concept of internal security from one that attempts almost exclusively to minimize our losses to one that places greatly increased emphasis on maximizing our gains.

OUR purpose is to analyze the policies on which the nation's security-screening program is based and to suggest two ways in which these policies could be changed to make them contribute more positively and effectively to the strengthening of the United States and the nations of the free world. Four points seem basic to a consideration of the security program.

1) A security-screening program is made necessary by the peril of the times. Espionage and sabotage, the communication of classified information to unauthorized persons, and infiltration by enemy agents and sympathizers must be guarded against. No prudent government could take any other course.

2) Examinations of the character of persons likely to be entrusted with vital information must go beyond a determination of loyalty. A person may be of unquestioned loyalty and still be a risk. If he is careless, if alcohol loosens his tongue, if close relatives in territory under enemy occupation make him subject to pressure, then to give him access to vital information endangers the nation, even though his loyalty is unchallenged.

3) The security program is for the protection of the whole community. It is true that many scientists have a special interest in the security problem, for the intimate dependence of military strength upon scientific progress means that security-screening affects them more than it does most people. But the welfare of the nation must be the controlling factor, not the interests of an individual or the welfare of a particular group. The policies must be comprehensive, and their application must be impartial.

4) Security-screening programs are a means to an end rather than an end in themselves. Their purpose is to conceal plans, to thwart enemy intelligence efforts, and to assist in the development and maintenance of such scientific, technologic, and industrial preeminence as will protect us against the danger of successful attack. Security-screening measures play an important role in that process, but the role is inherently a defensive and negative one. Such measures keep a potential enemy from learning some facts about our armed force, but they do not increase the size of that force. Temporarily they keep an enemy from learning the characteristics of weapons being developed, but they create no new weapons.

The last of these four points needs more extended consideration, for it has not been discussed as much as have the other three, nor have its implications been as widely considered. Basically, the issue is that secrecy is not an end that is desirable in itself but is a means toward an end. Thus the degree of secrecy, the conditions under which secrecy is desirable, and the risk of losing secrecy are all to be considered in terms of their contribution to the development and maintenance of the military, industrial, and moral strength which are our ultimate protection against effective attack.

The role of secrecy in defense has, for reasons that are historically obvious, been developed in a military setting in which the concept of maintaining security through secrecy had validity. Communication codes, troop strength and disposition, strategic plans, and other such information can be kept out of enemy hands, at least temporarily, by adequate security safeguards. Although such information eventually becomes obsolete, or is compromised through operational use, until this happens secrecy is proper and effective.

But a new situation confronts us now that military strength depends so essentially upon science, for scientific knowledge cannot be kept secret by the security practices that serve to safeguard military information. Progress in science is a cumulative process in which each scientist builds upon what is already known; through research and intellectual effort he adds his bit to scientific knowledge. National boundaries and security systems simply cannot contain this process. Scientific knowledge will continue to grow as long as men are curious about the world around them. The state of learning in a nation affects the rate of scien-

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tific progress; and the state of technology affects the speed and volume with which a nation can translate scientific findings into practical applications, be those applications of a military or of a peaceful nature. In scientific knowledge one nation may lead another, and in the application of scientific knowledge to military problems one nation may progress along lines not yet recognized by another as being feasible or important. When this is the case, security precautions may provide an advantage of time. But among advanced nations the difference is of time only. The basic fact is that there simply are no such things as permanent scientific secrets. Even the time difference is sometimes lacking; recent decades have been filled with instances in which the same fundamental discovery or the same military application appeared practically simultaneously in two or more countries.

Once it is recognized that there is no such thing as a permanent scientific secret, the whole picture changes. If security demands scientific superiority, and if superiority cannot be achieved by attempts to keep scientific progress secret, then how can superiority be achieved and maintained? Clearly the security of the nation requires the most favorable circumstances for the advancement of science, an environment that will foster a healthier, more imaginative, more energetic development than that which serves the enemies of freedom.

The truth of these ideas has not yet been generally recognized. In fact, the belief is widely held that, by taking sufficient precaution, we can safeguard the scientific secrets now in our possession, and that taking these precautions is therefore the most effective means available of maintaining our national security. These beliefs have led to the negative concept of security that is in current use. This concept assumes that we possess secrets that give us an edge of superiority. It assumes that the loss of a few secrets is likely to mean the difference betwen success and failure. But instead of trying to determine what information is of such critical importance, it is assumed that we must safeguard the security of large amorphous categories of information.

So pervasive has this type of thinking become that it has blurred the distinction between information that is vital and information that is not, between that which can be kept secret and that which cannot. There remains, of course, a proper role for secrecy to play. The disposition of troops and plans for troop movements, the kinds and capabilities of new weapons and the plans for their use if necessary—all such information obviously should be protected, and the relatively few people who must have access to it clearly need to be carefully screened. Under certain circumstances this may also be true of scientific knowledge. It is quite possible that an important scientific discovery that has profound implications for defense is made during a time of emergency. The time of discovery is thus sometimes an element, and under such circumstances the discovery should be held secret until it is known that a potential enemy also has it. These cases involve the difficulty of deciding between the advantages of classifying a discovery and the advantages of giving it to the scientific community. The burden of proof that a discovery should be classified rests squarely on the classifier.

But not all knowledge belongs in the classified category, and—admitting that the categorization is sometimes difficult—for such information as does not, the emphasis in our thinking should be on the positive side of progress rather than on the negative side of secrecy. With scientific knowledge advancing in many countries, as it most certainly is, our major effort should be on further progress and more advanced application instead of upon preserving the secrecy of the scientific knowledge we already have. We cannot possibly keep scientific knowledge secret; but we can hope to keep ahead of our potential enemies in basic knowledge and in the application of that knowledge.

A positive program of preserving national security by keeping ahead would substitute the question *How can we best aid national progress?* for the negative question *How can we avoid the danger of leaks?* Instead of asking *How can we minimize our losses?* it would ask *How can we maximize our gains?* If—as is likely—we should be numerically outnumbered, our superior strength must come from making better use of the material and human resources we do have. It follows that ability to make positive contributions to the nation's welfare and progress should be a primary criterion of a person's suitability for any position other than positions involving access to the types of information that must properly be closely guarded. We do not find that this criterion is now, in actual practice, the primary one. It is necessary to ask *What security risk is incurred in employing this person?* But it is also vital to ask *What risk of delayed progress or diminished achievement is incurred in not employing him?* Granting the obvious fact that every person is to some extent, however small, a security risk, screening boards are faced with the difficult task of assessing the size of the risk and then balancing that risk against the gains that may accrue if the risk is taken. It appears that in practice the potential gains have been given little consideration, while great emphasis has been placed upon the risk.

We propose two changes. First, that greater weight be given to a man's potential contributions. The risk involved must still be considered, but for any given position we can afford a larger risk if we stand to make a great gain than if we can expect only a small one. The difficulties of determining and properly weighting the positive factors which should be given greater consideration are clearly great. But scientists would welcome the opportunity to cooperate with government officials in developing appropriate standards and procedures. Even with such standards, decisions would be necessary; and many of the decisions would be difficult to make, for the whole man should be considered, his strengths and possible contributions as well as his weaknesses and possible danger.

Our second proposal offers much less difficulty. We

propose that the risk be measured with more regard for the nature of the work to be done than has frequently been true in the past. No satisfactory justification has yet been advanced for screening persons engaged in unclassified research, in say biochemistry, by the standards appropriate for screening those who have access to the details of war plans and advanced weapons. As a matter of logic, there is no question of security in unclassified basic research. There is a question of loyalty; both public opinion and the opinion of scientists would usually hold against the supplying of public funds to a scientist of established disloyalty. But demonstrated disloyalty, or even a strong presumption of disloyalty, is a different matter from security risk. Disloyalty is not to be tolerated anywhere, but stringent security precautions are appropriate only when the information to be guarded justifies the stringency.

The classification of basic research is likely to retard the development of both peaceful and military technology. Basic research thrives on the free interchange of ideas and information. The free discussion of research findings and methods allows criticism, permits the discovery of error, stimulates improvement, and furnishes the original clues which lead sometimes to the development of new weapons and more frequently to the development of peaceful applications of science. When the free flow of basic scientific information is stifled, technologic development must inevitably suffer, and the greatest loss is to the nation that enjoys the highest state of learning and the most advanced technology.

It is easy to overdraw the distinction between two such policies as the negative one we are criticizing and the positive one we are advocating, and perhaps we have done so. Nevertheless, there is an important difference in the effects of the two. Under a policy that attempts to maximize gains, we would encourage the interchange of scientific information; we would attempt to use as many people of high ability as we could, even though not all could safely be used in the more sensitive positions.

A policy that attempts to minimize losses leads to quite different attitudes and effects. A costly aspect of current procedures which seems to have been generally neglected in official circles and which would be largely obviated by a positive approach to security is the wastage of time and talent, the lowered efficiency, and the slowing of progress that result from the excesses of current procedures. We can afford the time that goes into the investigatory process itself. We can justify the money costs. But can we afford to have government service become less desirable, to diminish the effectiveness of research and development programs, to retard the flow of information to and among our own scientists, to deprive federal agencies of the help of consultants who possess important information and rare skills the agencies would like to use, or to base support for unclassified fundamental research on the political ideology of the investigator and his associates? The lowered morale, the lost time and efficiency, and the denial to the nation of the use of some persons of great talent add up to a bill of unknown but certainly large size, a bill we pay for our negative method of maintaining security. Were time, talent, and effectiveness so wasted for any other reason, those responsible would be considered guilty of sabotage of the first order.

A positive program of security can be developed. It requires boldness; it demands continued belief in the fundamental loyalty of American scientists, engineers, and industrialists and in their ability to keep the United States ahead of potential enemies. It would foster the development and effective use of the resources of knowledge, talent, and enthusiasm which can keep us ahead. Such a program would strengthen the democratic spirit of freedom and of progress which is the hope of the free world.

Human Ecology: A Problem in Synthesis*

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PEKING man, most ancient of our near kin, is not more than a million years old. The earth as a separate planet is at least 2000, perhaps 3000, million years old. The species of Pleistocene mammal to which we belong has been present for only the last 30 sec of the 24th hour of earth's existence. On this scale, agriculture and urban life are less than 0.5 sec old, while modern power technology based on fossil fuel compares with a very fast "instantaneous" snapshot.

We are an explosion. For the first time in earth history, a single species has become dominant, and we are it. The power and intensity of our pressure upon environment is without precedent. Our numbers increase at a net rate—conservatively—of 1 percent a year. This means a net gain of more than 50,000 a day, and doubling in a generation. This also means increasing demand for space in which to live and move and increasing demand for food and other necessities from the space that is left.

Man thus becomes his own rival, or rather the victim of his own rival needs. The modern landscape

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abounds in evidence of the resulting confusion. We do not know whether to cherish the forest as a source of essential raw materials and other benefits or to remove it for the space it occupies. We expect a river to serve as both vein and artery carrying away waste but bringing usable material in the same channel. Nature long ago discarded the nonsense of carrying poisonous wastes and nutrients in the same vessels. We underwrite the cultivation of marginal land in the face of surpluses which we pile up while millions elsewhere are underfed. We increase our consumption of water vastly but discard the water that falls upon our expanding cities and highway systems. At the same time our heavy machinery and other mass-production methods in agriculture are reducing the permeability of the rural landscape, adding more runoff to the waste of rainfall that occurs by evaporation owing to excessive clearing of the land.

In our concern to preserve freedom we ignore the long and painful struggle by which it was achieved and flaunt the safeguards our society has thrown about the dignity of the individual. In our desire to give every individual an equal opportunity we have neglected to take advantage of the differences between individuals which should enrich our society. We know better than to try to make a bird dog out of a mastiff or a greyhound. We secure the best trainers we can for promising horses and dogs but allow our ablest students to idle through our school systems. With the costliest educational establishment in the world, the products of our secondary schools are ill-trained in comparison with those of the Old World, and we are amazed when one of the latter wins a college degree here in a year. The teacher, who hands on the heritage of our society, has a status below that of doctor, lawyer, or successful businessman.

We deplore the increase of juvenile delinquency while doing little to combat the idleness, lack of recreation, and the flood of evil printed material which probably contribute to it. Vandalism in the New York park system alone runs to hundreds of thousands of dollars a year.

We apply science—aside from medicine—chiefly to the production of consumer's goods, while its application to the conserving of raw material lags behind, speeding up only when the pocketbook is pinched.

Yet in countless cases we have shown that we can, in our form of society, meet and deal with every one of the problems just enumerated. The trouble is that we do so, if at all, by a crude process of trial and error rather than on the basis of principle. Principles and methods for applying them do exist, or can be developed, for the kind of problems in question are ecological. Whoever tackles them, or however we classify them, they involve the relationship between *Homo sapiens* and his environment, physical, biological, and social. Thus they concern the ecologist.

There are several theories on how science develops, and a measure of truth in each. The classical notion has emphasized the importance of individual genius. Men like Joseph Mayer in his *Seven Seals of Science* stress the importance of a logical order of discovery, running the scale from mathematics and astronomy on to biology and social science. Recently we have heard much of the economic factor—science arising in response to urgent practical need. In beginning my discussion with a statement of such practical needs in the field of ecology I do not mean to exclude the importance of creative minds or the need for knowledge upon which to build. I merely want to make clear that modern society requires our services, whether it calls for them or not.

Nor do I wish to fall into the error that long beset medicine and still, in a measure, distorts sociology. Any study that concentrates only on what is wrong—whether it be bodily disease or social pathology—while neglecting the normal and healthy must fail. The ancients knew a great deal about disease but did not understand health. Modern medicine began when attention was turned to the structure and functions of the *normal* human body. I sometimes fear that much social science is still preoccupied, as ancient medicine was, with pathology. Too many students seem to feel that sociology is a matter of counting privies or crusading against abuses in our society. Of this, I shall have more to say later.

Human ecology is concerned not only with the present but with the past. This is assuredly one of the most challenging areas of research. Although archeology has been chiefly a source of intellectual and esthetic satisfaction, it is, I believe, far more generously supported than the study of present-day ecology. And since the present and future of any community are expressions of its past, we may expect the study of archeology and history to have a practical bearing on the critical question of man's future. For an example, what is already known of the relationship between human cultures, climate, and erosion in the Basin of Mexico furnishes more than a clue to its present problems. Similarly, enough is known of human vicissitudes in our own Southwest to make clear that the present policy of expanding economy in that area is suicidal. Let me hasten to add that a sound economy is possible in both areas but not in terms of existing practices.

Something of the span and complexity of human ecology is evident from the personnel of the panel in which this paper was originally presented. My colleagues included a zoologist who is also a limnologist and a student of climatic history; a botanist who is a working geneticist and taxonomist, with a lively interest in the origins of agriculture and domesticated plants; a geographer of catholic interests, deeply concerned with the record of primitive man and his activities in the New World; and a cultural anthropologist who has a firsthand knowledge of the processes within and among human societies as they relate to their subsistence base. What we all seem to have in common is an interest in process and, thus, in the past as a key to the present.

Each of us has his areas of most intensive study, but if any of us are specialists, it is in a very broad sense

of the term. Human ecology is not so much a specialty as a scientific activity which must draw upon a wide range of the specialties. What is important is the work to be done rather than the label. It is well to recall Ivor Richard's remark that any definition is simply an invitation to others to use a term in the sense we have defined it. No one is bound to do so, at least until there has been general acceptance. Had some of our pioneers in ecology understood this principle, we of today might have escaped some of the criticism and misunderstanding which, even among our biological colleagues, continues to haunt us and handicap our efforts.

The advantage of *human ecology* as a label does not lie in the dubious opportunity to set up new departments and professorships—always a temptation in our competitive society. The merits of this label are rather in the encouragement it offers to workers in seemingly unrelated fields to become better aware of one another and of common interests and responsibilities.

The historian James Malin of Kansas is almost unique in his profession in having made a thorough study of the ecological literature dealing with the area of his interest—the western grasslands. The economist Erich Zimmerman of Texas, in the early pages of his volume, *World Resources and Industry*, shows keen insight into man's ecological role. The same may be said of the geochemist Harrison Brown of Pasadena, who has recently published *The Challenge of Man's Future*. The book entitled *Human Ecology* by the sociologist Amos Hawley of Michigan is likely to be laid aside by the ecologist as an intricate study of modern institutions, unless one happens to note his enlightened discussion of the meaning of human ecology. How many of us know what the magnificent work in regional planning by Lewis Mumford and others owes to the pioneer efforts of the plant ecologist Patrick Geddes? More of us perhaps are aware of the influence of ecological interests and companions upon the statesmanship and philosophy of the late General Smuts.

With few exceptions these pioneering efforts have come from the other side of the quadrangle. Yet there have been efforts in the past from our own side. The venerable but lively C. C. Adams, one of the founders of the Ecological Society of America, has long had very clear notions on the subject and at least twice before has arranged programs on it, inviting social scientists to participate with us. Unfortunately, the limitations under which the Ecological Society operates did not permit the publication of any of the papers, effectively discouraging our colleagues in other fields from further efforts. This is no reflection on our able and devoted editorial staffs but rather an illustration of the meager financial resources of a society whose potential service to the common welfare is at least equal to that of other organizations that are handsomely endowed with headquarters, staff, storage facilities, and means for flexible publication policies.

For this unfortunate situation I have no immediate or spectacular solution to suggest. We must continue to turn out sound and meticulous research, as we have in the past, inspired by such examples as that of our president, John Potzger, who in spite of teaching and administrative work that would tax any of us, is producing an amazing amount of excellent investigation.

I am well aware of the handicaps under which many ecologists are now carrying on. Some of these handicaps can be lightened if we can establish more general confidence in ecology as a respectable intellectual enterprise. There still exists among our colleagues—even those within the biological sciences—a measure of uncertainty and misunderstanding about ecology. This attitude has two extreme manifestations. Least flattering is the view that the work of the ecologist is superficial at best and consists largely of an emphasis of the obvious. The other and more sympathetic view is almost as destructive in its effect. It is the view that ecology is important enough but requires such profound knowledge of all other phases of science, particularly of biology, that its study must be indefinitely postponed. This, of course, keeps it from being readily available to all but the most persistent of departmental students. Where either attitude prevails, it operates to keep ecology from getting into the introductory course where much of it properly belongs.

Now it is not possible to control the way others may feel about us, but it is possible to see that they do not misunderstand us. If this happens, the chances are that we have failed to *make ourselves understood*. As an aid to better understanding there is no substitute for clear exposition in speech and writing. Such clarity is not, as some suppose, a gift of the gods, but the product of hard work, attention, self-discipline, and, above all, constant revision. As it goes in the profession "the art of writing is the art of applying the seat of the pants to the seat of the chair."

Our discourse should be simple. Technical terms should be our servants, not our masters. Whatever we write or say, we should be mindful of its place in the general scheme of knowledge. I have been interested for years in having a journal of American science that would equal in quality and readability the British *Nature*. One of the obvious faults of our own journal *Science* has been that many of its contributions seem to be of too narrow technical interest. Actually this is because most writers do not start out with a clear explanation of what and why. Yet the present editor, Duane Roller, tells me that when articles do come in with such good introductions, experts to whom they are referred generally say "Cut this out. Everybody knows it." Everybody in this instance means the specialist. It is not only the modern poets who use a special form of language. A consistent policy of making ourselves more widely palatable and better understood might perhaps make us more appreciated.

Of the utmost importance is the need to see that the ecologist's point of view is embodied in elementary science teaching. This is more than a measure of self-preservation for our discipline—it is a matter of re-

sponsible citizenship. The 75 to 90 percent of our beginning students who take no further work in biology will presently be faced with decisions in their own communities, whether urban or rural, that can be much more intelligently made if those students understand a few ecological principles. Yet if one examines the textbooks and syllabuses used in many introductory courses, one finds that ecology, if there is any, has been dragged in by the heels, when it should have been used to give perspective to the whole course. Many, if not most, courses are set up as a slow and dramatic unveiling of the process of evolution, yet fail to make clear the profound ecological basis upon which it rests.

There should at least be a protective statement of the kind used in detective stories—"Any resemblance to ecology, living or dead, is purely coincidental." Again, I would be the last to quarrel with the magnificent work now being done in such fields as intermediate metabolism and the ultramicroscopy of the cell. But the whole still remains more than the sum of its parts, and the parts should not be allowed to obscure the entity in the eyes of any beginner.

I have mentioned the matter of citizenship. Here the ecologist, not only as a teacher, but as a participant, has one of his greatest opportunities. It is an open secret that our Government failed to utilize its biologists as well as it might have during World War II. Using biological—largely ecological—techniques, the British registered some notable achievements. One of my former students was responsible for very effective tactical successes in the Pacific area, thanks to his ecological training—not because he was recognized as an ecologist, but because his military rank made it possible for him to try novel and unconventional methods.

One reason for the formation of the AIBS was our feeling that in matters of high policy our brethren in the physical sciences seemed to be regarded as the spokesmen for all science. Like good children, we were not to speak unless spoken to, and then largely on specific problems of medicine and agriculture. Here again, as in academic circles, the fault may be partly our own.

Perhaps we need to remind ourselves that the long road to constructive statesmanship begins at the local level, for the ecologist as well as for the future senator. I have yet to study a community that could not use, in solving its immediate problems, the kind of assistance an ecologist is peculiarly able to render. One can reach out at random for examples. Take the problem of juvenile delinquency. Like that of communicable disease, it relates to the availability and distribution of space. Where there should be at least an acre of recreational space for 100 people, none of our major cities can approach this figure. Even Boston, which is beginning to look like the Paris of the New World, has less than half this proportion, or did at last accounts. With a national population that has increased more than 50 percent in the past half-century, and with our present augmented birth rate, the problem of urban encroachment on the rural landscape is becoming more and more acute. Who can see better than the ecologist what this involves in terms of functional community relationships—space, waste disposal, access, suitable land use, growth, and the general organic equilibrium so essential to the intangible values that make life a decent enterprise?

This raises a delicate problem for the scientist who is likely to think of public affairs as involving partisanship. There are, of course, certain risks inseparable from American citizenship, one of them being the willingness, when necessary, to stand up and be counted. The scientist, like the rest of us, must be prepared to take the duties, as well as the privileges, of our system when the occasion requires him to do so. However, his position is in some ways unique, justifying his avoidance of partisan politics insofar as possible. It is the role of science in political life to supply light rather than heat. There is usually plenty of the latter. There is seldom enough unprejudiced, impersonal evidence from competent sources to guide those who have to make decisions, either at the polls or in government. So far as information of this kind can be had, it is the obligation of the scientist to furnish it.

Since the ecologist should understand the dynamics of his community, he is in a position to furnish not only information but guidance in its use. In this he will need intuitive good sense, of course. But he can also draw upon a considerable body of principles, if he will acquaint himself with the viewpoint of the modern cultural anthropologist. The concept of culture patterns and its corollaries as developed by this group of workers will furnish him with a practical means of analysis and operation.

I discussed this concept as it relates to ecology informally for the layman in a little book called *This Is Our World,* published in 1937 and now out of print. A brief but somewhat more formal account is to be found on page 300 of volume II of *Medical Physics* edited by the late Otto Glaser. It is conveniently presented from the standpoint of the anthropologist in the well-known book *Culture Patterns,* written by the late Ruth Benedict.

The essential point for us is that man is functionally related to his environment in terms of the characteristic pattern of his particular culture. The power of this idea as an instrument of analysis and operation lies in the fact that it shifts the focus from the individual to the general framework of accepted practices and values from which the individual derives his sanctions. The concept of culture patterns leads us also to a study of the functional controls of any community under observation. Although it does not eliminate the factor of individual responsibility, it reveals the means that every culture possesses of modifying its own form and thus gives an efficient approach to better adjustment.

Charles Jones, graduate student at Yale, has reported a case among a group of Navajo where every effort had been made by conventional means to induce

the Indians to adopt certain improvements in land use essential to a sound economy. These efforts were fruitless until the new practices were put into effect by an ex-rodeo rider who lived among them and whose horsemanship had invested him with great respect in the eyes of the Indians. Similarly, Mexico has some of the most enlightened forestry legislation on our continent, but it remains impotent until something can be worked out that makes sense to the Mexican in terms of his own culture. In our own highly industrialized culture all of the sound and fury over water pollution accomplished little until organized business, industry, labor, and sport sensed a common threat and began to join forces on the problem. The task still remains of awakening some thousands of municipalities to their responsibility. It is significant that Milwaukee, with its German cultural heritage, has been a pioneer in abating pollution and utilizing waste.

Many of the ecological maladjustments in our own society are urgent, costly, and aggravating in the extreme to those who sense them. It is a constant temptation to expend one's energy in condemnation and crusade and to satisfy one's instinct for moral indignation when the issue seems so clear-cut. But the constructive procedure, as in any ecological problem, is to analyze the processes with which we are dealing, determine the factors involved, and then go to work. In practice this means that conflicting interests and centers of influence must be identified. Those who represent them can often then be induced to state their respective cases and listen to one another. More frequently than not, in my experience, this leads toward constructive action. It may not come at once. Obstacles and delays are to be taken as a matter of course. Human beings are more refractory than the so-called "lower organisms," and time is less important than trend. Patience, persistence, good communication, and good nature are essential and, in the long run, most effective.

Lest it be thought that these suggestions are academic, I might explain that I have seen them used to improve ecological legislation, administration, and community action in widely separated parts of the United States during the past two decades.

For example in 1937 the farmers of Oklahoma descended upon Governor Marland demanding some kind of legisation that would enable them to combat soil erosion, which had become a prime menace to agriculture. The governor appointed a committee whose chairman was familiar with the idea of culture patterns. The American culture pattern seemed during the 1930's to be in a state of flux, with traditional responsibilities being unloaded upon, and cheerfuly assumed by, a benevolent federal government. Yet even Russia, under rigid controls, was evidence that every culture has its own momentum which has to be reckoned with. It can be guided and modified by its own mechanism, but it cannot be disregarded. And so, although the climate was favorable to radical innovations, the committee—with competent advice—drafted a law authorizing the voluntary formation of local districts with technical advice to be supplied by Washington. For this there was plenty of precedent in the American pattern.

It so happened that the governor was at loggerheads with his legislature, whose able leader viewed with a jaundiced eye anything that emanated from the office of His Excellency. The latter was in sympathy with the then national administration, while the legislature was extremely conservative, and particularly suspicious of the lavish federal expenditures being used as an antidote to hard times. A bitter fight was in prospect, but it was avoided by quiet and reasonable explanations, based strictly on the most traditional American practices and upon the firsthand knowledge that the chairman had of ecological conditions within the state.

Self-interest is a strong element in American culture, but so is self-respect. A practical politician is usually grateful for an issue that is strongly rooted in the scientific realities of the situation, provided that we translate it into terms he can understand. Businessmen are interested in the character of the communities in which they live as well as in the profits they can get there. And a satisfying community is largely the expression of sane ecological conditions. Who can better analyze and explain such conditions than the ecologist, trained as he should be to read the landscape? But he must be equipped to analyze the human community and understand the forces at work within it as well.

Once the ecologist expands his analysis of such phenomena as destruction of soil or native vegetation, or of disturbance of the hydrologic cycle so that he sees them, not in the personal terms of foolish individuals or bad laws, but rather in terms of the basic structure and values of his society, he is in a position to be highly effective. And he will be even more so as he learns to detect examples of good ecological adjustment. These are more frequent than he may have thought. For him these are as useful as an architect's drawings to a builder.

When we as a profession learn to diagnose the total landscape, not only as the basis of our culture, but as an expression of it, and to share our especial knowledge as widely as we can, we need not fear that our work will be ignored or that our efforts will be unappreciated.

There is no adequate defense, except stupidity, against the impact of a new idea.—P. W. BRIDGMAN.

News and Notes

Astronomical Highlights in 1954

The ten top astronomical highlights of 1954 picked for Science Service by Harlow Shapley of Harvard University are as follows:

1) Out of the abundance of contributions in the field of radio astronomy—from Holland, England, Australia, the United States, and Canada—especially noteworthy was the work of John D. Kraus and H. C. Ko of the College of Engineering of Ohio State University. They mapped much of the northern sky as it would be seen to an eye sensitive only to radiation of wavelength about 122 cm. The Milky Way is clearly recorded in this radiation as well as the Virgo group of galaxies, the intensely bright galactic nucleus, and some special hot spots in Centaurus, Cygnus, and especially Cassiopeia. To this radio eye, globular star clusters remain undiscovered.

2) The dedication of the new Pulkovo Observatory, near Leningrad, built on the site of war ruins, brought again into the national and international picture a large institution that a century ago was sometimes rated as the astronomical capital of the world.

3) Two large enterprises in the astronomy of position were completed. At the Lick Observatory, Director C. D. Shane, assisted by C. A. Wirtanen, completed the first series of plates for the sky-mapping program, planned many years ago by the former director, W. H. Wright; and at the University of Minnesota, W. J. Luyten finished the Bruce proper motion survey, adding 19,000 stars to his lists of those with appreciable motion—an investigation that has continued steadily for 25 yr. Some decades from now the Lick Observatory series of plates will be repeated and will then provide the best material ever assembled for the study of star motions referred to distant galaxies. Evaluation of the rotation of our galaxy is one of the goals of this long-range investigation.

4) At the Mexican National Astrophysical Observatory, Tonanzintla, Puebla, Guillermo Haro, director of the Tonanzintla and Tacubaya observatories, discovered and measured a large number of "slow-motion" flarelike stars in the nebulosities of Orion.

5) Milton Humason of Mount Wilson-Palomar Observatory completed at least one phase of his elaborate study of the radial velocities of 580 galaxies, which, when supplemented by N. U. Mayall's measurements at the Lick Observatory of the red shifts of nearly 300 galaxies, will provide the basic information on the expanding universe. Humason has found 20 galaxies with velocities in excess of 25,000 km/sec, with the greatest speeds slightly exceeding 60,000 km/sec.

6) New and highly promising developments were reported in the utilization of solar energy, including (i) the large-scale production of solar cookers in India, (ii) a practical solar cooker developed in California that can attain a temperature under best conditions of 8500°F (not much less than the temperature of the solar surface), and (iii) some partially revealed developments in the Bell Telephone Laboratories and the Wright Air Development Center that involve cells and batteries that absorb the solar radiation and make it efficiently available for heating.

7) The production of a color-magnitude array for the globular cluster Messier 3, reaching down for the first time to stars of smaller luminous intensity than that of the sun, was accomplished by H. C. Arp and A. R. Sandage with the Hale telescope on Mount Palomar.

8) A new and appealing proposal was advanced by Dean B. McLaughlin of the University of Michigan to account for the markings on Mars. They can be reasonably explained as analogs to the dust bowls of the Southwest. The "trade winds" on Mars (where the absence of oceans and of long mountain ranges permits them to behave otherwise than with us) pile up, in drifts and ridges, the sand, dust, and volcanic ash, some of which, because of the lack of oxygen in the Martian atmosphere, can have a greenish tone. Thus, both the canals and the life on Mars are disposed of as largely illusions produced by Martian meteorology. To provide the drift material, active volcanoes are required. Only an astronomer competent in geology and meteorology could have originated the theory.

9) Although only preliminary results have been reported, the wide atack on the total solar eclipse of June was noteworthy, and especially so was the 10-station program of the U.S. Air Force, which distributed observers all the way from Ontario through Labrador, Greenland, and Scandinavia to Iran.

10) An extensive and very valuable program of support for astronomical research was followed by the National Science Foundation, and considerable assistance was given to pure astronomical investigations by the U.S. Air Force, the U.S. Navy, and the National Bureau of Standards.

In summary, the past year has been noteworthy for interesting contributions all the way from the heart of classical astronomy to the astronomical borders where the scientists of other fields, such as radio and engineering, contribute importantly to our knowledge of stars, galaxies, interstellar dust, and the solar system.

Marine Biology in Latin America

A group of Latin American specialists in marine biology met in Concepción, Chile, 15–17 Sept., to study the possibility of establishing an international network of marine biological laboratories in Latin America and to consider other ways of facilitating collaboration in this field among the Latin American countries. The meeting was convoked by the UNESCO Science Cooperation Office for Latin America and was a follow-up on recommendations made by a previous UNESCO meeting on international laboratories held in Montevideo in 1952. The scientists attending the recent meeting came from Argentina, Brazil, Chile, Cuba, Mexico, Peru, Venezuela, and Uruguay. The FAO Regional Office in Santiago collaborated actively in the organization of the meeting.

After studying the current status and potential of marine biological research in Latin America, the delegates discussed extensively the establishment of the international network of laboratories. It was unanimously decided to create immediately, under the auspices of the UNESCO Science Cooperation Office, a Latin American Committee to coordinate and facilitate

research in marine biology. The Committee is to remain in office until a permanent organization has been set up. The meeting requested the UNESCO office to prepare the initial draft of a convention for the proposed group of laboratories and to call a meeting of the official delegates in order to establish the permanent organization.

The meeting also considered other immediate steps for promoting research pending realization of the more far-reaching recommendations. It was suggested that in 1955 the UNESCO office arrange two training courses on the methodology of marine biology research and a symposium on plankton. In addition it was recommended that the *Marine Biology Journal*, edited by the Montemar Station in Chile, should be converted into an international publication with an international (Latin American) editorial board.

The Brazilian representatives to the meeting, duly authorized by the governor of the state of São Paulo, informed the delegates that they would put at the disposal of the UNESCO Science Cooperation Office the marine biological laboratories, stations, and research vessels of the state of São Paulo. This offer will make possible the prompt initiation under UNESCO auspices of international research and training programs.

A. ESTABLIER, *Head*
UNESCO Science Cooperation Office
for Latin America
Montevideo, Uruguay

Science News

The editors of the *Saturday Review* asked Norbert Wiener of Massachusetts Institute of Technology to discuss the question "Does a great mathematical theorist—or a genius like Mozart—spring out of nowhere, or is there some way society can help? Education?" In his response, "**Science, Monkeys, and Mozart**," which appears in the 20 Nov. issue of the *Review*, Wiener makes a plea for a vigorous, free atmosphere of intellectual society and warns that the modern urge toward more size and more secrecy is endangering those traditions by which all genius is most encouraged.

> . . . The genius of Mozart and the genius of the really great mathematician, and, in particular, of that sort of mathematician who learns his trade young, are different only in direction, but not in character. . . . We may throw aside once for all the claim that, because the greatest scientists are men of genius and relatively uninfluenced by their formal education, we may conclude that scientific education is irrelevant to genius. A scientist must know what is being done in order that the very individuality of his own work may come to full fruition. He must live in a world where science is a career, where he has companions with whom to talk, and in contrast with whom he may bring out his own *sève*. . . . Thus, the universities are the mothers of science. . . . Many of today's American scientists are working in Government laboratories, where secrecy is official, and they are "protected" by the deliberate subdivision of problems to the extent that no man can be fully aware of the general bearing of his own work.
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> . . . There are scientific ideas which we can trace clearly to the time of Leibiniz, a quarter of a millennium ago, which are just beginning to find their applications in industry. Can a business firm or a Government department, moved primarily by the immediate needs for new weapons, compass this period of time in its backward glance? . . . The great grove of science must be left to long-time institutions capable of formulating and maintaining long-time values. . . .
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> One of the rare and incalculable benefits for which we must provide if the race is going to survive is the sudden emergence on the scene of great and original intellects. . . . The handling of [these] . . . must be transferred to more stable institutions which have as their task the fostering of general culture. Among these are the foundations and the universities, which at least contemplate such a continued existence.
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> The great industrial and government laboratories are important and have a real function to fulfil, but they are not enough. . . . It is popular to believe that the age of the individual and, above all, of the free individual is past in science. The example of Manhattan Project and the atomic bomb is being taken as the norm of scientific development all along the line. There are many administrators of science and a large component of the general population who believe that mass attacks ("crash-programs") can do anything, and even that ideas are obsolete.
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> . . . It is perfectly possible for the mass attack by workers of all levels from the highest to the lowest to go beyond the point of optimum performance and to lose many really good results it might obtain in an unreadable ruck of fifth-rate reports. . . . If a new Einstein theory were to come into being as a Government report in one of our super-laboratories there would be a really great chance that nobody would have the patience to go through the trash published under the same auspices to discover it.

The Weizmann Institute of Science in Rehovoth, Israel, has announced the completion of **synthesis of sphingosine** by David Shapiro of its organic chemistry department. Sphingosine is part of a group of complex compounds occuring in natural form in the spinal cord, brain, blood corpuscles, liver, spleen, and kidneys. Certain diseases cause an over-production of the sphingosine complexes in the organs involved, while a deficiency of the substance has been observed in the nerves of diabetics and arteriosclerotics. The synthesized compound can be made with radioactive isotopes of nitrogen or carbon.

Forty-one German scientists who worked on Hitler's guided-missile projects **became American citizens** on 11 Nov. All have been U.S. residents for almost 10 yr and all are employed at the Government's arsenal at Huntsville, Ala. Wernher von Braun, known for his writings on space travel, is the unofficial leader of the group.

A new concept of "**mental temperature**" may explain why some scientists are more than 100 times more productive than others, according to a report to the Operations Research Society of America by William B. Shockley, director of the Weapons Systems Evaluation Group of the Department of Defense. The basis for the report was a statistical study of production of scientists at Los Alamos Scientific Laboratory, the National Bureau of Standards, and other locations. The differences in rates of scientific production are much larger than other variations among men. No runner can race a mile 100 times faster than another and one man does not speak 100 times faster than another, Shockley said.

The concept of mental temperature or capacity likens the production of ideas to a chemical reaction. A small increase in temperature can speed the reaction considerably. If a man's mental temperature is twice that of another, he is likely to be a hundred times more productive. Mental temperature may be related to the number of ideas a scientist can consider at one time. Small increases in this capacity may greatly increase his productivity. Shockley pointed out, however, that a study of the relationship between salary and productivity shows that to win a 10 percent raise, a research worker must increase his output between 30 and 50 percent.

A recent issue of *Modern Metals* reports the use of **portable dairy barns** by farmers in Oklahoma and Texas. Designed by the Oklahoma Agricultural Experiment Station, the barns cost $2500, can be moved by truck, and will house four cows each.

Too many H- and A-bomb explosions may create **excessive radiation** in the world's atmosphere, therefore a limitation of the number of test explosions conducted is being considered. An idea that may be practical has been put forth by Pierre Auger, French physicist and head of the natural science section of the United Nations Educational, Scientific and Cultural Organization in Paris. Auger was French delegate to the United Nations Atomic Energy Commission. He has suggested that countries might agree to limit their nuclear tests: for instance, the United States and Russia might restrict themselves to a maximum of ten annual explosions each; Britain, three; France, two.

In an article in the *Weekly Review* of the French Academy of Science another French physicist, Nobel prize winner Louis de Broglie, has listed four long-term effects of hydrogen bomb explosions. He states that "Any increase in the number of explosions will bring unpredictable changes and a growing disequilibrium of the natural conditions to which animal and plant life has slowly adapted itself."

If tests are fired repeatedly without regard to the radiation danger, we may drift into a pollution of the air that it will be impossible to remedy. Recent articles in the *New York Times* and the *Washington* (D.C.) *Post* and in many other leading publications have considered this subject with growing concern.

Radio waves at a frequency of 60 kcy/sec can be used as a standard of **time accurate to one part in a billion,** according to a report in the 20 Nov. *Nature* by J. A. Pierce of Harvard University; H. T. Mitchell of the Radio Experimental and Development Laboratory, Post Office Engineering Department, London; and L. Essen of the National Physical Laboratory, Middlesex. This is 200 times more accurate than the present system, which also depends on radio waves but those that are in the high-frequency range.

The 60-kcy/sec wave, although broadcast with only 10 kw of power from Rugby, was picked up by scientists at Harvard University. These results "are clearly of significance in problems of frequency control, international frequency and time standardization and navigational aids based on phrase comparison," and are probably of interest in a much wider field.

Speaking at a meeting of the Commercial Chemical Development Association, W. F. Mitchell of Shell Petroleum, Ltd., reported that the **production of chemicals** in the entire free world outside of North America is approximately 8 percent smaller than in the United States alone. Outside of North America and the Soviet Zone, the approximate distribution of production is 20 percent in Western Germany, 22 percent in the United Kingdom, 40 percent in other West European countries, and 18 percent in all other areas.

Since 1938 the production of chemicals in Europe, including the United Kingdom, has increased by about 80 percent, compared with about 200 percent for the United States. Since 1950, however, production in Europe has risen by almost 30 percent, compared with a 20 percent rise for the United States.

At the same meeting H. J. Taufen of the Hercules Powder Co. pointed out that foreign technical journals are often a valuable source of information, and that studying them is a necessary means of assimilating the background information, the point of view, and the mode of operation of technical people in other countries. Lack of such background can be a serious drawback in foreign transactions. Taufen also emphasized the value of patent literature as a fertile source of new ideas.

Announcement has been made that **Edward Teller,** nuclear physicist, will make his television debut over San Francisco's educational TV station in the near future. It is reported that he will deliver a series of talks on the atom.

Claiming that in 1937 she discovered a new species of actinomycetous organism which Selman A. Waksman used in the development of streptomycin following their collaboration in research work, Mary A. Marcus has filed a $5 million patent infringement **suit against Waksman.** Named codefendants with Waksman are the Rutgers Research and Endowment Foundation and Merck and Co., Inc. A similar suit, filed in 1951 against Waksman by Albert Schatz of National Agricultural College, was decided in favor of the plaintiff.

The U.S. Department of Labor bulletin, *Employment Opportunities for Women in Professional Engineering,* indicates that **women engineers** should find job prospects excellent. The bulletin estimates that there are approximately 3600 employed women engineers and some 3000 women who are engineering aides, draftsmen, and technicians. The total of 6600 accounts for about 1.2 percent of all engineering employment. Chemical engineering engages the smallest number of women engineers.

In the October *American Library Association Bulletin,* S. R. Sapirie, manager of Oak Ridge Operations, U.S. Atomic Energy Commission, describes the integrated organization of the five **Oak Ridge libraries.** He states:

> The indispensability of the library to the atomic energy program is unquestioned. . . . A standard preliminary step in the launching of a research or scientific development effort is a thorough search of books and documents in the field to be investigated. . . . The [Oak Ridge] libraries have a carefully chosen, all-useful collection of books and documents totalling in excess of 125,000.

Sapirie concludes that it is "only through the library that continued progress in nuclear science and other fields can be assured in the future. And only with suitable libraries and library service could nuclear science have reached its present stage of development."

The faculty of the University of Wisconsin recently published memorial resolutions on the deaths of three members of its department of botany: **Charles Elmer Allen, Norman Carter Fassett,** and **H. Gerhard F. Sander.** The three professors were outstanding in their respective fields: cytology, plant taxonomy, and genetics. Dr. Allen was 82 at the time of his death in June 1954 and had served on the faculty for more than 40 yr, until 1943, when he retired with emeritus status. A member of the National Academy of Sciences and the American Philosophical Society, he had held high offices in many scientific organizations; from 1918 to 1926 he was editor-in-chief of the *American Journal of Botany.* Outstanding among his many scientific accomplishments were his discovery of sex chromosomes in certain of the lower plants, his pioneer work on the study of sex inheritance in plants, and early work on chromosome morphology, numbers, and behavior. While his early endeavors were directed to purely cytological studies, much of his later work was of a genetic nature. In addition to the papers reporting his own work, Dr. Allen was coauthor of two well-known textbooks.

Dr. Fassett died in September at the age of 54. He joined Wisconsin's faculty in 1925 as an instructor in botany and in 1944 became a full professor. A forceful and stimulating personality, Dr. Fassett was noted for the excellence of his lectures; sparkling wit, dry humor, and a wealth of illustrative material characterized his delivery. He was the author of more than 100 professional papers and several books. A founder of the American Society of Plant Taxonomists, he was its president when he died. Because of his profound enthusiasm for the out-of-doors and his interest in conservation, no student ever left his classes without an increased perception of America's natural resources. During World War II he was in Colombia with the U.S. Cinchona Mission searching for new sources of the critical drug, quinine.

Dr. Sander was born and brought up in Frankfurt am Main and, at the age of 16, was already doing research in plant cytology. Although he was only 39 when he died on 23 July after difficult years of chronic illness, he had completed extensive cytological research and was planning further studies in another of his major fields of active interest, human genetics. He left Germany in 1934 to study with Leonard Huskins at McGill University, where he obtained a Ph.D. After research at McGill, the University of California (Berkeley), Harvard University, and Columbia University, he rejoined Huskins at Wisconsin as an assistant professor in 1952. Following an early interest in the cytology of *Funkia,* he conducted investigations throughout his life on the cytogenetics of wheat and oats. While at McGill he played a major role in a program covering a variety of genetical and cytological problems in mice.

William Lloyd Evans, 83, professor emeritus of the department of chemistry, Ohio State University, died on 18 Oct. in Columbus. He headed the department from 1928 to 1941. A student of J. U. Nef, Dr. Evans concentrated his main research in the alkaline reactivity of carbon compounds, especially carbohydrates. He was an outstanding teacher of freshman chemistry and an inspirational director of graduate research.

In 1929, he received the Nichols medal (N. Y. section, American Chemical Society), and in 1942 the American Institute of Chemists medal. He was elected president of the American Chemical Society in 1941.

Scientists in the News

Lionel Whitby, vice chancellor of the University of Cambridge and Regius professor of physics, will be a guest of the University of Texas Medical Branch, Galveston, on 13 Dec., for a series of conferences and seminars on blood disorders.

Lawrence R. Hafstad, director of the Reactor Development Division of the Atomic Energy Commission in Washington, has resigned, effective 1 Jan., to join the staff of the Chase National Bank as atomic energy consultant. Hafstad will represent Chase in conferring with various groups planning the development of atomic energy by private industry.

J. F. G. Clarke has been appointed curator of insects in the U.S. National Museum. For the past 7 mo, following the retirement of Edward A. Chapin, **O. L. Cartwright** has served as acting curator.

Linus Pauling of California Institute of Technology was able to go to Stockholm this month to receive the 1954 Nobel prize in chemistry. A passport has been issued that permits him and his wife to travel around the world. Pauling plans visits to India and Japan in response to invitations from fellow scientists. Last year he could not accept his invitation to India because he could not obtain State Department permission to make the trip.

Fontaine C. Armistead has been appointed director of the Virginia Institute for Scientific Research in Richmond. He has been at Massachusetts Institute of Technology for the past 7 yr as a staff member in the physics department and also as an employee there of the Texaco Development Corp. His fields of activity have been isotope separation by centrifuging, mass spectrometry, gas diffusion, vacuum engineering, and nuclear science instrumentation.

The Hoover medal "for distinguished public service" was presented to **Alfred P. Sloan, Jr.**, chairman of the board of General Motors, at the annual dinner of the American Institute of Consulting Engineers. The medal is awarded annually by a board composed of representatives of the national societies of civil, mining, mechanical, and electrical engineers. Sloan is president of the Alfred P. Sloan Foundation, which has contributed to a number of colleges and universities. The foundation made possible the Sloan-Kettering Institute for Cancer Research, a component of the Memorial Cancer Center, New York, of which Sloan is a manager.

John A. Fincher, head of the department of biology at Howard College, Birmingham, Ala., has been elected assistant to the president of the college. He will continue his duties in the biology department.

William A. Pennington, former chief metallurgist and chief chemist of the Carrier Corp., has been appointed professor in the chemical engineering department at the University of Maryland, effective 1 Dec.

Henry L. Cox, vice president in charge of the chemical division of the Corn Products Refining Co., gave the 1954 Robert Kennedy Duncan memorial lecture at Mellon Institute. He spoke on "Some aids to a scientific career." The Duncan lecture is presented annually to perpetuate the memory of the institute's first director, who originated the fellowship system of research that has been in operation there since 1913. Last year's lecturer was John C. Warner, president of Carnegie Institute of Technology.

The Columbia University School of Mines has awarded the first Ambrose Monell medal for distinguished achievement in mineral technology to **Lloyd M. Pidgeon,** of the University of Toronto. He is discoverer of the "Pidgeon Process" for production of metallic magnesium.

The $1000 Wien award for outstanding research in cancer cytology was presented to **J. Ernest Ayre** at a dinner meeting of the Southern Society of Cancer Cytology in St. Louis on 8 Nov.

Kenneth C. D. Hickman, formerly vice president in charge of research for Distillation Products Industries, and consultant to the Eastman Kodak Co., has been appointed research consultant to the Consolidated Vacuum Corp., Rochester, N.Y. He will join with the company's other research people in implementing a program aimed at developing radically new methods for producing high vacuum. Announcement of the appointment was made in conjunction with the opening of Consolidated's new plant in Rochester.

LeRoy M. Ennis, professor of oral roentgenology in the School of Dentistry and in the Graduate School of Medicine of the University of Pennsylvania, has been granted a 2-yr leave of absence to accept appointment as adviser to the Government of Egypt on dentistry and public health affairs. Last year Ennis served as a Fulbright professor in the University of Cairo, where he reorganized procedures and modernized the system of dental education.

At the recent annual meeting of the British Institution of Radio Engineers the recipients of institution premiums for papers published during 1953 received their awards. The chief honor, the Clerk Maxwell premium, was presented jointly to **W. Saraga, D. T. Hadley,** and **F. Moss** for their paper "An aerial analogue computer" that appeared in the organization's *Journal* for April 1953. Other awards were as follows:

The Heinrich Hertz premium to **B. E. Kingdon** of The Atomic Energy Research Establishment, Harwell, for his paper "A circular waveguide magic-tee and its applications to high-power microwave transmission" (published in May 1953).

The Louis Sterling premium to **D. A. Bell** of the electrical engineering department, University of Birmingham, for his paper "Economy of bandwidth in television" (published in September 1953).

The Sir J. C. Bose premium to **S. K. Chatterjee** of the Indian Institute of Science, Bangalore, for his paper "Microwave cavity resonators—some perturbation effects and their applications" (published in October 1953). This is the first award of this premium, which is given for the most outstanding paper by an Indian scientist or engineer.

The Marconi premium to **Paul Eisler** of Technograph Printed Circuits Ltd. for his paper "Printed circuits—some general principles and applications of the foil technique" (published in November 1953).

The Dr. Norman Partridge memorial award to **J. A. Youngmark,** formerly with Goodmans Industries Ltd., for his paper "Loudspeaker baffles and cabinets" (published in February 1953).

Awards of Brabazon, A. F. Bulgin, and Leslie McMichael premiums have not been made this year.

Oswald Tippo, chairman of botany and dean of the graduate school at the University of Illinois, has been appointed chairman of the department of plant science at Yale University, effective at the end of the present academic year.

In November **Vilhjalmur Stefansson,** Arctic explorer, celebrated his 75th birthday at Dartmouth College, where since 1947 he has been Arctic consultant and where his extensive library on the polar regions is housed. It has been estimated that one of five published items in the Stefansson collection is not to be found in the Library of Congress, and that 40 percent of the collection's Russian material is equally rare.

Stefansson, who made his first Arctic expedition in 1906, was honored at a dinner and at a reception. He received messages of congratulations from many societies, including the National Geographic Society, the American Geographical Society, the Arctic Institute of North America, the Association of American Geographers, the Geographical Society of Berlin, and the Geographical Societies of Chicago and Philadelphia.

Stefansson was the first to demonstrate that a man from a temperate zone could live in the Arctic on the same terms as the Eskimos and survive. Altogether, he spent 11 yr living with the Eskimos of the Canadian Arctic and Greenland. In fact, on his first major expedition his supply boat became ice-bound and never caught up with him. He moved in with the local Eskimos, adopting their clothes, their food and their work habits, and learning their language.

Cornell University has announced the appointment of **Don W. Fawcett,** assistant professor of anatomy at Harvard Medical School, as professor and head of the department of anatomy at Cornell Medical College in New York, effective 1 July 1955. He succeeds Joseph C. Hinsey, who left the position last year to become director of the New York Hospital–Cornell Medical Center. Fawcett's research has been mainly in microscopic anatomy, including studies of the circulatory adaptations of aquatic animals, the mechanism of implantation of mammalian ova, the histochemistry of adipose tissue, and the ultrastructure of the kidney and liver as revealed by the electron microscope.

Joseph F. Libsch, professor of metallurgy at Lehigh University, has received the annual $2000 award from the American Society of Metals for outstanding contributions to the teaching of metallurgy. The prize was presented to him at the 36th metallurgy congress and exposition held recently in Chicago.

Léo Marion, director of the division of pure chemistry of the National Research Council of Canada, has been elected president of the French Canadian Association for the Advancement of Science for 1954–55. Marion was honored with the degree of Doctor of Science *honoris causa* by Laval University on 7 Nov.

Tyozabura Tanaka, citrus taxonomist and professor of horticulture at Tokyo Agricultural University, will spend the current academic year in the department of subtropical horticulture at the University of California at Los Angeles as a Fulbright scholar. He will devote most of his time to his studies of the classification of citrus fruits and their relatives according to natural relationships. He will also continue his revision of the well-known work *Sturtevant's Notes on Edible Plants,* of which he says: "Although this is one of the most complete works on the subject of edible plants, it omits many known in China and Japan and to American Indians."

George L. Cunningham has been appointed head of the chemistry department of Horizons, Inc., Cleveland, Ohio, an industrial research organization. Previously he was associate professor of chemistry at the University of Cincinnati, and at the same time technical director of Commonwealth Engineering in Dayton, Ohio, and supervisor in chemistry at the Southwest Research Institute at San Antonio, Tex.

During November the Messenger lectures on submarine geology were given at Cornell University by **Phillip H. Kuenen,** head of the geology department at the University of Groningen, the Netherlands.

On 14 Dec., **H. P. Grace** of E. I. du Pont de Nemours and Co., Inc., Wilmington, Del. will receive the 1954 Junior Award in chemical engineering from the American Institute of Chemical Engineers. Given annually for "the paper judged most outstanding of those published by Junior members of the Institute during the last three years," Grace was cited for two papers, "What type filter and why?" and "Resistance and compressibility of filter cakes."

Headquarters of the Air Research and Development Command has announced that **Gertrude Blanch,** American mathematician who was born in Poland, has joined the staff of the Aeronautical Research Laboratory at Wright Air Development Center, Dayton, Ohio. Dr. Blanch, best known for her work on mathematical tables, is a specialist in obtaining numerical values for problems arising in mathematical physics and theoretical engineering. She is a pioneer in the application of large-scale digital computers and has authored more than 40 scientific publications, including 20 volumes of mathematical tables.

Her most recent work has been with Consolidated Engineering Co., Pasadena, Calif. Before that she was associated with the Bureau of Standards and the Institute of Numerical Analysis at the University of California at Los Angeles.

Earle R. Caley, professor of chemistry at Ohio State University, has received a citation for his contributions to humanistic studies. The presentation was made by the department of classical languages on behalf of the American Classical League.

United Cerebral Palsy has presented its annual $1000 Max Weinstein award for outstanding scientific achievement in the field of cerebral palsy to **Seymour S. Kety,** associate director in charge of research for the National Institute of Neurological Diseases and Blindness and the National Institute of Mental Health, U.S. Public Health Service, Bethesda, Md. Kety was honored for his pioneering work in measuring the blood flow through the human brain. The results of his research are of fundamental importance to an understanding of cerebral palsy and many other neurological and medical disorders.

Norman C. Miller and **John D. Steely,** staff members of the University of California's Los Alamos Scientific Laboratory, have been jointly awarded the 1954 Coolidge award by the Society for Nondestructive Testing. They were honored for their article, "Some experimental findings and operating practices in betatron radiography," which was presented before the society at its 13th annual meeting and which appeared in the Nov.–Dec. 1953 issue of the society's journal. The article summarizes 3½ yr of experience at Los Alamos Scientific Laboratory in applying a 22-Mev betatron to various problems in radiographic inspection.

Edward L. Nelson, technical director of the Signal Corps Engineering Laboratories, Fort Monmouth, N.J., has been appointed scientific chief of Research and Development for the Army Signal Corps.

The Acheson medal and award was presented to **George W. Heise** by the Electrochemical Society during its recent annual convention in recognition of his outstanding technical achievements and his many contributions to the welfare and growth of the society. The award, consisting of a gold medal and $1000, is the society's highest honor. Associate director of the research laboratories of the National Carbon Co. in Cleveland, Ohio, at the time of his retirement last year, Heise is an authority on primary batteries and for many years has written on this subject for the *Encyclopedia Britannica.* At present he is chairman of advisory battery panels for both the Office of Naval Research and the National Research Council.

Heise has worked on many types of batteries. He invented the "air cell," an alkaline carbon-zinc system that uses oxygen from the air instead of manganese dioxide as an energy source. These cells have been in commercial production for over 20 yr. Heise holds 22 patents on dry cells, 32 on alkaline cells, and 18 others in electrochemical fields. His publications on corrosion, electroanalysis, catalysts, photochemical reactions, photography, radioactivity, and sorbent carbons show the wide range of his interests. During World War II, as technical representative for the Chemical Warfare Service and the National Defense Research Council, he headed a research group that developed methods for making highly effective gas-mask carbon from domestic raw material.

Benjamin F. Greene, Jr., John V. Harrington, and **William H. Huggins,** all from the Air Force Cambridge Research Center, have been awarded the Air Force's decoration for exceptional civilian service.

Greene is the developer of VOLSCAN, the new Air Traffic Control System; Harrington has accomplished outstanding work in the field of data transmission; and Huggins has established new approaches in the fields of electronic hearing and communications.

The AFCRC shared with Wright Air Development Center of Dayton, Ohio, the honor of having the most civilian personnel receiving the high award. Only 13 civilians throughout the Air Force were selected. Both centers are under the Air Research and Development Command.

Appointment of two new research associates at General Electric Research Laboratory, Schenectady, N.Y. has been announced: **Henry J. Fisher,** formerly a metallurgist in the Department of Mines and Technical Survey, Ottawa, Canada, and **Glenn M. Roe,** a theoretical physicist from the Knolls Atomic Power Laboratory.

Three men were honored at a recent meeting of the Franklin Institute: **Walter A. R. Pertuch,** librarian, became associated with the institute in 1904 and is celebrating his 50th year of service; honored for 50-yr memberships were **Frank S. Busser,** Philadelphia lawyer, and **C. Mahlon Kline,** chairman of the board of Smith, Kline and French Laboratories.

Necrology

Russel Burton-Opitz, 79, heart specialist, author, former president of the New York Cardiological Society, and former associate professor of physiology at Columbia University, New York, 18 Nov.; **Earl F. Farnau,** 71, retired professor of physical chemistry at the University of Cincinnati, Cincinnati, Ohio, 17 Nov.; **James T. Grady,** 75, former managing editor of the American Chemical Society News Service, Winsted, Conn., 18 Nov.; **Thomas D. Jones,** 55, authority on rheumatic fever, former research director of the Good Samaritan Hospital in Boston, and medical director of the Helen A. Whitney Foundation, New York, 22 Nov.; **Henry Keller, Jr.,** 59, professor of agricultural economics at Rutgers University, New Brunswick, N.J., 22 Nov.

Abraham A. Low, 63, associate professor of psychiatry at the University of Illinois Medical School, Chicago, Ill., 17 Nov.; **Peter I. Lukirsky,** 60, physicist, author, and corresponding secretary of the Physico-Mathematical Union of the Russian Academy of Sciences, Moscow, 15 Nov.; **James H. H. Muirhead,** 88, engineer and inspector for the Isthmian Canal Commission during the building of the Panama Canal, Patchogue, L.I., N.Y., 20 Nov.; **Wallace D. White,** 84, electrical engineer and inventor, Red Bank, N.J., 17 Nov.; **Anna W. Williams,** 91, bacteriologist, former

president of the Woman's Medical Association, and retired investigator of diphtheria, rabies, and trachoma for the New York Department of Health, Westwood, N.J., 20 Nov.; **Robert S. Woods**, 77, authority on electrotherapy, author, and retired head of the department of physical medicine and electrology in the London Hospital, London, 20 Nov.

Meetings

The 4th **Conference on Scientific Manpower**, sponsored by the National Science Foundation, the National Research Council, the Engineering Manpower Commission, the Scientific Manpower Commission, and Section M—Engineering of the American Association for the Advancement of Science, will be held in Berkeley, Calif., 28–29 Dec., in conjunction with the annual meeting of the AAAS.

The first session of the conference will be on *Implications of the Findings of the Commission on Human Resources and Advanced Training*. Papers on the implications as they affect the natural sciences, social sciences, and science teaching respectively will be presented by Lee A. DuBridge, California Institute of Technology; Conrad Taeuber, Bureau of the Census; and Ralph Tyler, Center for Advanced Study in the Behavioral Sciences. The second session will deal with *Prospective Developments in Utilization of Scientists and Engineers*. Raymond Ewell of the National Science Foundation and A. L. Lyman of the California Research Corp. will read reports on the "Estimated volume of research and development expenditures in 1955 by government and industry." Another subject to be considered is *Selective Service and Military Reserve Developments*.

All sessions of the conference are open to the public, and those interested in the problems of scientific and technical personnel are cordially invited.

The 4th annual **Symposium on Blood** will be held at Wayne University on 22 Jan. 1955. Those presenting papers include M. Mason Guest, Peter B. Samuels, Charles Brambel, Theodore H. Spaet, Joseph M. Hill, Charles A. Owen, Morris Tager, Helen M. Ranney, Raymond Monto, Benjamin Alexander, Jack Carter, and George D. Penick. The meeting will be held in the auditorium of the College of Medicine. A cordial invitation is extended to all interested persons.

Scientists specializing in the behavior and effect of ocean waves met for the first time with America's leading ship designers and builders from 25 to 27 Oct. at Stevens Institute of Technology, Hoboken, N.J. The College of Engineering of New York University was co-host with Stevens. This joint meeting of the **Society of Naval Architects and Marine Engineers** and the **Council on Wave Research** was particularly significant in view of increasing scientific interest in the destructive and useful aspects of energy contained in sea waves. Most of the problems considered were concerned with better methods of measuring and predicting various types of wave motion, and the effects of waves on ships, seaplanes, and landing craft.

Chairmen of the sessions were Columbus O'D. Iselin, Woods Hole Oceanographic Institution; K. S. M. Davidson, director of the experimental towing tank, Stevens Institute of Technology; K. K. Cowart, engineer-in-chief, U.S. Coast Guard, Washington, D.C.; H. E. Saunders, Bureau of Ships, Washington, D.C.; J. W. Johnson, secretary of the Council on Wave Research and professor of hydraulic engineering, University of California; H. de Lucc, assistant naval architect in the central technical department, Shipbuilding Division of Bethlehem Steel Co., Quincy, Mass.

The 3rd annual meeting of the **American Society of Tropical Medicine and Hygiene** was held jointly with the 21st annual meeting of The American Academy of Tropical Medicine and the 29th annual meeting of the American Society of Parasitologists at Memphis, Tenn., 3–6 Nov.

The Bailey K. Ashford award in tropical medicine (established by Eli Lilly and Co.) was presented to Joseph Greenberg of the National Institutes of Health, Bethesda, Md. The Joseph Augustin LePrince award in malariology (honorarium provided by the Michigan Chemical Corp.) was awarded to Brian G. Maegraith, dean of the Liverpool School of Tropical Medicine: it was accepted on behalf of Dr. Maegraith by William H. Taliaferro, University of Chicago. A symposium on schistosomiasis, consisting of five papers, was presided over by Donald B. McMullen of the Army Medical Service Graduate School, Washington, D.C. The C. F. Craig lecture on "Recent advances in our knowledge of dengue and sandfly fever" was delivered by Albert B. Sabin of the Children's Hospital Research Foundation, Cincinnati, Ohio. Frederick J. Brady, International Division of the Public Health Service, Washington, D.C., presented as his presidential address, "The future of tropical medicine."

New officers are: pres.-elect, Asa C. Chandler, Rice Institute; v. pres., Donald B. McMullen, Army Medical Service Graduate School. Councilors for 4 yr are M. C. Balfour, Rockefeller Foundation, and T. H. Weller, Harvard School of Public Health.

Organization of the **Italian Genetics Society** (Associazione Genetica Italiana) has been announced. The president is G. Montalenti, and G. Magni of the Istituto di Genetica, Universita di Pavia, Italy, is secretary-treasurer. Councillors are C. Barigoyzzi, A. Buzzati-Traverso and A. Chiarugi.

The second **Colloquium on Biochemical Problems of Lipids** will be held at the University of Ghent, Belgium, 28–30 July 1955, just preceding the 3rd International Congress of Biochemistry at Brussels. Investigators who wish to participate should address inquiries to Prof. R. Ruyssen, St. Janvest 12, University of Ghent, Belgium.

The **Association of Missouri Geologists** was organized at a meeting held at the office of the geology department of the St. Joseph Lead Co., Bonne Terre, Mo., 10–11 Oct. The idea for the association originated with O. R. Grawe, chairman of the geology department of the School of Mines and Metallurgy, University of Missouri. Through the courtesy of the American Association of Petroleum Geologists, a preliminary meeting was held on 15 Apr. during that society's annual meeting in St. Louis. Plans were made then for the organizational meeting.

The new association has 103 charter members of whom 61 were present at the Bonne Terre meeting. The following officers were elected: pres., O. R. Grawe, chairman, geology department, School of Mines and Metallurgy, University of Missouri; v. pres., Norman S. Hinchey, v. chairman, department of geology and geological engineering, Washington University; sec.-treas., Walter V. Searight, principal geologist, Missouri division of the U.S. Geological Survey and Water Resources, Rolla. Members of the executive committee are Frank Snyder, geologist for the St. Joseph Lead Co., Leadwood, and Athel G. Unklesby, associate professor of geology at the University of Missouri.

At the Bicentennial Conference of the **Columbia University College of Pharmacy** the following papers were read: "The role of drugs in nutrition," William H. Sebrell, Jr.; "Pharmacy's challenge in the problem of cancer," Cornelius P. Rhoads; "Chemotherapy in infectious diseases," Henry Welch; "The pharmaceutical approach to mental diseases," Nathan S. Kline; "Widening horizons in endocrine therapy," Wilbur W. Swingle; "Cardiac drugs and the aging problem," Harry Gold; "Pharmacy's impact on the economics of health," Louis I. Dublin; "The greater economy of today's health," George Bugbee; "Safeguarding your health," Lloyd C. Miller; "The pharmacist serves with many hands," George D. Beal; "The community's health information center, the pharmacy," Newell Stewart; "The role of pharmacy in the future of public health," W. Paul Briggs.

These papers will be published in a commemorative volume.

The **Society of Nuclear Medicine** will hold its 2nd annual meeting in Portland, Ore., 17–19 June 1955.

This society was formed in Jan. 1954 to facilitate the integration of the products of research into the practical application of radioactive isotopes in medicine, and at the same time to help its membership and keep abreast of developments.

There are two types of membership. Regular membership is open to authorized users of isotopes and their direct collaborators. They may hold their degrees in any field that is involved and an M.D. is not required or emphasized. Associate membership is open to people with adequate scientific education who are interested but not actively engaged in the field. There are now 141 members in 18 states and 5 foreign countries. Current officers are pres., Asa Seeds, 507 Medical Arts Bldg., Vancouver, Wash.; pres.-elect and chairman of the membership committee, Milo Harris, 252 Paulson Medical Dental Bldg., Spokane, Wash.; sec., Arthur Livermore, Reed College, Portland, Ore.; treas., Norman J. Holter, Helena, Mont.

A number of discoveries in the general knowledge of blood and use of blood for therapeutic purposes were announced before the **Conference on the Cellular Elements and Plasma Proteins of the Blood,** which convened in Cambridge, Mass., 15–16 Nov., under the auspices of Protein Foundation, Inc., a nonprofit organization dedicated to research on blood and related biologic problems, and to the qualitative control of biologic products. Among the new developments reported were the following: (i) The establishment of methods that make possible the utilization of red cells that have been preserved by deep-freezing in glycerol —thus enabling the effective stock piling of this fundamental blood component for ordinary medical use as well as for civil defense; (ii) the localization, employing new methods of fractionation, of a number of factors that exist in human plasma only in minute quantity, including the growth hormone, insulin, a gonadotropic factor related to the atrophy of the reproductive organs in menopause, and a phagocytosis-promoting factor that plays a vital role in combating infection.

Basic to much of the discussion that took place at the conference were the several papers dealing with the perfection of the ADL-Cohn Blood Fractionating Machine, which was developed by the late Edwin J. Cohn and his associates at Harvard University. This apparatus, which has entered into production only within the last several months, takes blood from the veins of the donor, and, in one continuous process in a closed sterile system, removes calcium to prevent coagulation, reduces temperature to minimize chemical change, quickly separates the blood into a series of constituents (white cells, red cells, platelets, gamma globulin, stable plasma protein solution, and so forth), and packages each fraction in a sterile plastic container, ready for immediate use or transfusion. By varying the internal design of the replaceable centrifuge cartridges, different types of separation can be effected. The machine was developed and engineered in collaboration with Arthur D. Little, Inc., of Cambridge, which is now producing a limited number for distribution to qualified research centers.

Reports were also delivered on the progress that had been made in preserving platelets and in employing them therapeutically in certain cases of hemorrhagic bleeding. Less than 3 yr ago general medical opinion held that platelets were so fragile that their preservation could not practicably be considered. By using gelatin as a suspensory medium, however, it has been possible to preserve platelets for many months. Preliminary clinical tests employing preserved platelets in hemorrhagic conditions related to platelet deficiency have been altogether favorable.

Contrary to expectation, they can be used repeatedly on the same patient without reduction in effect. Although the supply of platelets is still extremely limited, emergency shipments have been made in certain cases.

The work on platelets is also of the greatest importance to the treatment of radiation injury. The two most serious effects of atomic radiation are the destruction of the white cells of the blood, without which the body has no resistance to bacterial infection, and the destruction of the platelets, without which the body is subject to uncontrollable hemorrhage. While there is still a vast amount of work to be done in this entire field, the establishment of methods of preserving and banking platelets, and their demonstrated effectiveness in clinical use, represents a highly important advance.

Society Elections

United Engineering Trustees, Inc.: pres., James L. Head, Anaconda Copper Mining Co.; sec., John H. R. Arms; treas., Waldo G. Bowman, McGraw-Hill Publishing Co. The vice presidents are W. J. Barrett, N.J. Bell Telephone Co.; and W. F. Thompson, Westcott and Mapes, Inc.

Hawaiian Academy of Science: pres., C. G. Lennox; pres.-elect, W. A. Gortner; sec., D. C. Cox; treas., B. Krauss.

New Mexico Academy of Science: pres., Sarah L. Cook, Albuquerque High School; v. pres., John Harty, New Mexico Institute of Mining and Technology; sec.-treas., C. Clayton Hoff, University of New Mexico.

International Association of Milk and Food Sanitarians, Inc.: pres., I. E. Parkin, Pennsylvania State University; pres.-elect, I. Van Nortwick, Kansas State Dairy Products Ass'n.; sec.-treas., H. H. Wilkowske, University of Florida; J. D. Faulkner, U.S. Department of Health, Welfare and Education; H. Barnum, Denver Department of Health and Hospitals. The vice presidents are H. S. Adams, Indiana School of Medicine, and P. Corash, New York City Health Department.

American Society for the Study of Arteriosclerosis: pres., L. N. Katz, Chicago, Ill.; v. pres., A. C. Corcoran, Cleveland, Ohio; sec.-treas., O. J. Pollak, Box 228, Dover, Del.

AAAS, Springfield, Massachusetts Chapter: chairman, Henry A. Walter, Monsanto Chemical Co.; v. chairman, Seth Arsenian, Springfield College; sec.-treas., Philip H. Cinis, 73 Melha Ave., Springfield.

AAAS, Arctic Branch, Alaska Division: pres., Earl H. Beistline, University of Alaska; v. pres., Clyde J. Beers, Coast and Geodetic Survey, College, Alaska; sec.-treas., J. C. Cain, University of Alaska.

The Association of Consulting Chemists and Chemical Engineers, Inc.: pres., Charles Davidoff, Consulting Chemical Engineer; v. pres., Lincoln T. Work, Consulting Chemical Engineer; sec., Elliot A. Haller, Haller Testing Laboratories; treas., Percy E. Landolt, Landolt & Whitney.

American Society of Clinical Pathologists: pres., Frank B. Queen, University of Oregon; pres.-elect, Emma Moss, Charity Hospital, New Orleans; v. pres., Elbert DeCoursey, Armed Forces Institute of Pathology; sec.-treas., C. G. Culbertson.

Education

The department of mechanical engineering in the Technological Institute of **Northwestern University** has expanded its facilities by the creation of the Gas Dynamics Laboratory. Now almost 1 yr old, the laboratory has been working on fundamental problems underlying the operation of gas turbines, jet propulsion, and rockets. Financed by the university, the laboratory serves three main functions in providing: (i) research work for graduate students; (ii) instruction in the fields of compressible fluid-flow and high-velocity combustion processes; (iii) unclassified research under contracts from private industry and/or governmental groups; (iv) the organization of postgraduate symposiums and conferences for those interested in high-velocity flow processes.

So far the emphasis in research has been in the field of turbulent combustion such as that encountered in jet engines. However, preparations are under way to study the combustion instability problems encountered in rocket motors. Four day and three night courses are being offered. A symposium to discuss aerothermochemistry has been announced and is scheduled for 22–24 Aug. 1955.

The National Heart Institute of the U.S. Public Health Service is conducting a research **training program in enzyme chemistry** at the Institute for Enzyme Research of the University of Wisconsin under the direction of D. E. Green. Candidates must possess a Ph.D. or M.D. degree. Stipends conform to those in effect for postdoctorate research fellows of the Public Health Service. Application forms and further information may be obtained from the Institute for Enzyme Research, Madison, Wis.

Establishment of a cooperative research affiliation between the School of Veterinary Medicine of the **University of Pennsylvania** and the **Mexican Government's** Institute of Livestock Research (the Institute de Investigaciones) located at Palo Alto, near Mexico City, has been announced. Financial support for the project to the extent of $18,000, is being supplied by the Foreign Operations Administration. The E. R. Squibb and Sons de Mexico, a subsidiary of the Olin Mathieson Chemical Corp. of New York, and also E.

R. Squibb and Sons, New York, are parties to the affiliation and will also assist in financing the Palo Alto undertaking.

Mutual cooperation in the investigation of contagious animal diseases of importance to both countries, with active assistance from the two governments, is the prime objective of the affiliation. Geoffrey W. Rake, microbiologist who joined the faculty of the university's veterinary school a year ago, will direct research work for the university at Palo Alto. He has been named chairman of a faculty scientific committee to guide the project.

The FOA grant will enable the faculty to encourage graduate training for Mexican veterinarians and other scientists who are interested in pursuing additional education and experience in the field of infectious diseases affecting animals, with particular emphasis on those diseases transmissible to man.

Under terms of the agreement, the University of Pennsylvania is to have use of existing facilities of the Institute at Palo Alto. A main laboratory there has been set aside for collaboration in research. It has been designated as the Squibb-Mathieson Laboratory for Veterinary Research of the Ministry of Agriculture and Husbandry in Mexico and of the University of Pennsylvania. A dedication program was held 17 Nov.

Selected faculty members from the veterinary school in Philadelphia are to be sent to Mexico as principal investigators on research projects. In addition to available personnel, it was announced that the university has appointed Carlos España as a research associate in microbiology assigned to the Palo Alto laboratory. España is a native Mexican who, following his graduation from the University of Mexico, went to California to complete his graduate training in microbiology at the Hooper Foundation of the University of California.

Available Grants and Fellowships

The Educational Testing Service, Princeton, N.J., is offering two fellowships in psychometrics for 1955–56. These are $2500 renewable research fellowships that provide for training in the Princeton offices of the service in addition to a full-time program of graduate work for the Ph.D. degree at Princeton University in psychological measurement and allied fields. Students in the program are offered a broad training in various fields of psychology, including experimental, social, and theoretical psychology. Special training is also given in modern quantitative methods as applied to problems in learning and in attitude measurements as well as in the techniques of developing aptitude and achievement tests.

Suitable undergraduate preparation may consist either of a major in psychology with supporting work in mathematics or of a major in mathematics with some work in psychology. However, in choosing fellows primary emphasis is given to superior scholastic attainments and demonstrated research ability rather than to specific course preparation. To be considered, a candidate must either (i) have taken the Graduate Record Examinations in 1954; or (ii) register by 13 Jan. to take these examinations on 27 Jan. 1955. *Fellowship applications are closed on 13 Jan. 1955.*

In a gift to the American Academy of Arts and Sciences in 1796 Count Rumford established a fund, the interest of which was to provide a Rumford award "to the author of the most important discovery or useful improvement . . . on Heat or on Light." Since 1832 a portion of the income of this fund has been devoted to supporting research. The designations, heat and light, have been interpreted broadly to cover the entire area of radiation and energy exchange. The research that may be supported therefore extends beyond physics into areas of chemistry, engineering, astronomy, biology, and geology.

Applications for research grants from the **Rumford Fund** may be sent to the Chairman of the Rumford Committee, American Academy of Arts and Sciences, 28 Newbury St., Boston 16, Mass. No prescribed form need be followed. Applications for grants for the coming year should be submitted *before 31 Jan. 1955.* A clear statement should be made of the objective of the investigation, the expected duration of the project, the institutional support, and previous contributions to the field by the applicant. In general the awards do not exceed $1000. It is felt by the committee that in spite of the present availability of larger research funds from various sources, there exists a need for small, free, uncommitted grants.

Grants and Fellowships

The Research Corporation, New York, has announced the award since 1 July of $124,000 in support of research in the physical sciences and mathematics. Grants from the **Williams-Waterman Fund,** which is administered by the Research Corporation, total $65,000. This fund was established in 1935 when Dr. Williams, Robert E. Waterman, and their associates assigned to the foundation their patents on the synthetic production of vitamin B_1.

Talladega College. E. H. Hoerger. Adsorption affinities of organic functional groups.

Pomona College. C. F. Allen. Asymmetric induction during catalytic hydrogenation of acyclic carbon-carbon double bonds.

Colorado Agricultural and Mechanical College. C. O. Guss. Intramolecular displacement of carboxylate ion.

University of Connecticut. Lewis Katz. X-ray studies in polymorphism.

Northwestern University. Vlasios Georgian. Synthesis of steroids.

Northwestern University. Kaj A. Strand. Research in double star astronomy.

Southern Illinois University. M. J. Arvin. Electrical effects at the surface of semi-conductors.

University of Chicago. S. MacLane. Program in pure mathematics.

Loyola University. Paul B. Pickar. Low temperature studies on the electrical properties of the semi-conductors lead telluride, lead selenide, cadmium selenide, and titanium dioxide.

Tulane University. H. B. Jonassen. Studies of metallated dye complexes.

University of Maryland. C. E. White. Determination of optimum wave length for exciting fluorescence and determination of the fluorescence spectrums for various chelate compounds of analytic importance.

Amherst College. James Nicol. Method of cooling by cascade adiabatic demagnetization and application of the method to an investigation of the magnetothermal properties of substances below 0.1°K.

Clark University. J. L. Bullock. Polarographic investigation of lakes of some hydroxyanthraquinones.

University of Massachusetts. R. S. Stein A correlation of polymer crystallinity and orientation as determined by x-ray diffraction, light scattering from solid films, and birefringence.

University of Mississippi. S. F. Clark. Synthesis of synergists for DDT.

Park College. Delta W. Gier. Study of the hydrazides of quinolinic acid.

Nebraska Wesleyan University. W. R. French, Jr. Atmospheric effects on ground level cosmic ray intensity.

Dartmouth College. David M. H. Kern. Kinetics of irreversible electrode reactions involving metallic ions and the constant current coulometric analysis with +5 uranium.

Rutgers University. C. E. Erickson. Study of mixed boron amines and their dimers.

Rutgers University. J. S. Showell. Mode of hydrogen transfer in the Doebner-Miller reaction.

Rutgers University. S. T. Zenchelsky. Modern methods applied to thermometric titrations.

University of New Mexico. R. R. Brown. Time variations of cosmic radiation.

New York University. B. R. Sundheim. The radial distribution functions of an ionic fluid.

Polytechnic Institute of Brooklyn. Rudolph Marcus. Studies on the behavior of the dicarboxylate ions.

Union College. G. W. Ewing. Investigation of chemical analysis by means of controlled cathode potential electrodeposition.

Duke University. W. M. Fairbank. Use of microwave oscillators stabilized by superconducting cavities to measure the critical velocity of superfluid flow in helium-2.

University of North Dakota. E. A. Whalin, Jr. π^-/π^+ ratio from deuterium near the photomeson threshold.

Case Institute of Technology. M. J. Astle. Investigation of ion exchange resins as catalysts for organic reactions.

Western Reserve University. R. L. Dannley. Synthesis of trifluoromethyl choline.

Western Reserve University. E. L. Pace. Calorimetric investigations of the heat capacity between 1 and 20°K.

University of Oklahoma. S. H. Wender. Chemical synthesis of radioactive quercetin and related flavonoid compounds.

Lewis and Clark College. J. H. Karle. Astronomical photoelectric photometry.

Carnegie Institute of Technology. M. Simnad. Heterogeneous condensation of metals from atomic beams and surface diffusion.

Lehigh Unviersity. E. M. Kosower. Properties of cyclopropylmethide ions.

Lehigh University. R. C. West, Jr. Preparation and reactions of a cage compound containing a silicon atom at the bridgehead.

Pennsylvania State University. E. A. Mason. Measurement of thermal diffusion in gases by means of radioactive tracers.

Swarthmore College. G. P. Haight. Use of substituted ammonium salts as precipitants for certain anions.

Temple University. M. D. Stern. Light scattering investigation of the (a) interaction of pepsin with bovine serum albumin as a function of pH, ionic strength and concentration of interactants.

University of Pittsburgh. R. J. F. Palchak. Thiophene syntheses: scope and limitations of the reaction between phosphorus pentasulfide and γ-Keto acids in solution.

University of Scranton. F. C. Witkoski. Hydrolysis of some aliphatic chloroethers.

University of Rhode Island. S. MacKenzie. Usnic acid, exploration of synthetic routes.

Prairie View Agricultural and Mechanical College. C. T. Stubblefield. Kinetics of the oxidation of $SmCl_2$, $YbCl_2$, and $EuCl_2$ in HCl solutions.

Saint Edward University. R. Fleck. Specificity in the Meyer-Schuster rearrangement and the Rupe reaction.

Texas Southern University. R. F. Wilson. Spectrophotometric and polarographic study of certain rare earth elements.

West Virginia University. C. W. Muth. Synthesis and properties of some azabenzazulenes.

University of Wyoming. F. J. Bueche. Strength of plastics.

American University of Beirut, Lebanon. Costas H. Issidorides. Preparation of ethers of pentaerythritol and preparation of trimethylene oxides.

Williams-Waterman Fund grants

University of Cape Town, Union of South Africa. J. F. Brock. Etiology of kwashiorkor.

Christian Medical Hospital, Vellore, India. J. S. Carman. Village and hospital survey of nutritional deficiencies, with especial reference to vitamin deficiencies in Vellore.

Women's Christian College, Madras, India. E. D. Mason. Aspects of nutritional problems related to the diets of South India.

Northwestern University. Two fellowships in the field of medical nutrition.

Adelphi College. L. D. Ellis. Role of riboflavin in storage of vitamin B_{12}.

Institute of Nutrition, University of the Philippines. C. R. Pascual and others. Evaluation of the protein quality of Philippine food plants and other protein foods.

South Pacific Commission, South Pacific Area. Brian Freeston. Analysis of Pacific Islands foods with particular reference to their vitamin content.

Louisiana State University. V. R. Williams. "Biotin-oleic acid interrelationship in micro-organisms."

North Texas State College. F. I. Scoular. Metabolism studies of young college women.

Instruments

A new electric **microgram balance** with a load capacity of 500 mg registers changes in weight with accuracy to 1 μg. A change in weight produces a torque moment that is equalized by a compensating current. The current can be used to operate any calibrated indicating instrument such as a milliammeter, reflection galvanometer, or ink recorder. The instrument, which operates from a 115-v 60-cy/sec power source, is equipped with a stabilized power supply, null indicator, range switch, sensitivity control, mechanical and electric zero adjustments, and an indicating instrument of the type desired. (Sartorius Div., C. A. Brinkmann and Co., Dept. Sc., 378–380 Great Neck Rd., Great Neck, N.Y.)

A circular, rotatable **Warburg apparatus** has been announced by Bronwill. The unit, 31 in. high and 20 in. in diameter, comes in two models, one for standard work and the other for photochemical work. Both models have six reproducible shaking speeds, three amplitudes, temperature constancy of ±0.01°C, magnetically-operated tilting reaction vessels, and a platform rotatable through 320 deg, which permits any of the 14 double-capillary, single-rod manometers to be easily read. (Bronwill Scientific, Inc., Dept. Sc., 131 Gould St., Rochester 7, N.Y.)

Large numbers of soiled pipettes can be cleaned quickly with a new automatic **pipette washer**. The apparatus pumps an automatically heated and controlled cleansing solution through the bore of the pipettes, completing a wash-rinse cycle every 55 sec. Five or six cycles are sufficient for thorough cleansing. The capacity is 200 pipettes per cycle. (E. Machlett & Son, Dept. Sc., 220 E. 23 St., New York 10.)

The RCL Scale of 4096 is a new **scaler** designed for use with linear amplifiers, differential pulse height selectors, and other equipment that produces relatively large output signals. The scaler is of the Higin-

botham type with a pentode Schmidt trigger discriminator input. Resolution is approximately 1 μsec. Cascade connection is provided for series operation of two scalers. All critical resistors are Allen-Bradley 1 or 2 w, with resistance tolerance of ±5 percent, and all tube sockets have beryllium copper contacts. The register is a 220-v d-c Veeder-Root panel-mounted unit. There is neither a high voltage supply, amplifier, nor clock. The transformer and choke are hermetically sealed and the plate supply voltage input capacitor is oil-filled. (Radiation Counter Laboratories, Inc., Dept. Sc., 5122 West Grove St., Skokie, Ill.)

Miscellaneous

A report on the *World's High Altitude Research Stations* has been prepared and is ready for distribution. The term *high altitude* is used to designate stations located above 7500 ft or above 2000 m. The report was prepared at the direction of the Joint Commission on High Altitude Research Stations, appointed originally by the International Union of Biological Sciences, reporting to the International Council of Scientific Unions. The work of collecting and editing the data on the stations was done by Robert Stampfli, secretary of the JCHARS, and by Serge A. Korff of New York University. Publication was financed by grants from the National Science Foundation and from the JCHARS.

The compendium gives the pertinent physical facts about each laboratory as reported by its director, and includes a listing of facilities at the station. The purpose of the listing is to enable any scientist having a problem that requires high altitude research facilities to ascertain what station or stations are the most suitable for his work. Data on approximately 50 stations located all over the world are listed. In addition there is a list of potential sites—that is, stations that have been occupied but no longer are active. The appendixes provide notes about electric power, about conversion of altitudes, and standard pressures and temperatures.

Copies of the report may be obtained gratis as long as the supply lasts by writing to Dr. Serge A. Korff, New York University, University Heights, New York 53, N.Y.; Europeans wishing copies may address Dr. R. v. Tavel, Hochalpine Forschungs Station, Buhlplatz 5, Bern, Switzerland.

The first complete medical directory of trade-mark and generally known products that might be involved in accidental poisoning in the home will be published within the next year. The book will list products, their hazardous ingredients if any, the degree of damage to be expected from swallowing them accidentally, and what to do about it.

Harold C. Hodge, professor of pharmacology and toxicology at the University of Rochester School of Medicine and Dentistry, and Marion Gleason, a research associate, have been working on the dictionary project for more than 4 yr. They have collected and analyzed data on about 15,000 products that will form the bulk of the dictionary's contents.

Callahan and Hollowell have announced publication of a weekly newsletter on the practical application of atomic energy and its by-products to industrial, agricultural, and economic uses. The new weekly is to be known as the *Atomic Energy Guideletter* and will have editorial offices in the Evans Building, 1420 New York Ave. NW, Washington 5, D.C. The editor-in-chief is Walter A. Shead, former Washington correspondent for the Western Newspaper Union.

The *Guideletter*, distributed on a private subscription basis, is designed to keep businessmen regularly informed on practical present and future uses of atomic energy and also on actions, policies, and licensing provisions of the Atomic Energy Commission. Callahan and Hollowell have been in partnership for several years in the publication of various newsletters of a specialized nature.

A final report on the Atomic Energy Commission's predoctoral and postdoctoral fellowship programs in the physical and biological sciences has been published by the University Relations Division of the Oak Ridge Institute of Nuclear Studies. The report is a valedictory for a program that, from 1 May 1948 until its termination on 30 Sept. 1953, provided support for 920 fellows at a time when no other major scientific fellowship program was in effect in this country. The AEC fellowship program was terminated when the National Science Foundation, which provides for a national fellowship program in the sciences, was established by act of Congress.

The AEC fellowship program was administered initially by the National Research Council. On 30 June 1950 administration was taken over by four regional fellowship boards: the Northeastern Fellowship Board, sponsored by Associated Universities, Inc.; the Midwestern Fellowship Board, sponsored by Argonne National Laboratory; the Western Fellowship Board, sponsored by the University of California; and the Southern Fellowship Board, sponsored by the Oak Ridge Institute of Nuclear Studies. The last, with administration centered in the University Relations Division, handled the entire program from 30 June 1951 until its conclusion.

Five programs are covered by the report: predoctoral fellowships in the physical sciences and in the biological sciences, and postdoctoral fellowships in the physical, medical, and biological sciences. Of the 920 fellowships awarded, 522 were for study in the predoctoral physical sciences; 213 in the predoctoral biological sciences; and 155 in the postdoctoral physical, medical, and biological sciences.

A limited number of copies of this report are available for use by offices or officials concerned with administration of fellowship programs and may be obtained by writing the University Relations Division of the institute.

Book Reviews

The Structures and Reactions of the Aromatic Compounds. G. M. Badger. Cambridge Univ. Press, New York, 1954. xii + 456 pp. Illus. $11.50.

This book is accurately titled; it relates precisely to structures and reactions of the aromatic compounds. It is well written and definitely readable. It is well documented and the mechanical features are excellent. It is not for the beginner in organic chemistry but should be very valuable to the advanced student and the researcher in the aromatic field. The author has accomplished his aims, as expressed in the preface, and has preserved an objective and broad viewpoint as well as a well-calculated balance of treatment. The literature up to the middle of 1951 has been employed, and the repeated statement that the "evidence on this point is inconclusive" and similar phrases are suggestive to other workers. In addition to a clear presentation, the choice of words is good in that the connotations are clear. A possible exception is, perhaps only to me, occasional confusion between molecular structures and formulas. Despite conventional acceptance and usage of *hybrid* molecule and its dictionary definitions, the word *hybrid* so used leaves something to be desired as a fully descriptive term. (I have no better term to suggest.)

Chapters 1 and 2 present an excellent review of the current status of knowledge and theory of the basic benzene molecule, its structure, its bonds, and internal-energy relationships. Chapter 3 pertains to more or less general properties of aromatic compounds. Chapter 4 treats generally addition reactions; Chapter 5, the aromatic double bond; Chapters 6 and 7, substitution reactions and the effect of substituents. Chapter 8 deals with the interesting Diels-Adler reaction; Chapter 9, photooxidation and photodimerization of aromatic compounds. Chapter 10 discusses the absorption and fluorescence spectra; Chapter 11, optical activity in aromatic compounds. Subject and author indexes are included.

Badger has drawn on world-wide literature and employed organic, physical, and mathematical evidences with a fine and critical sense of applicability and significances. For me, with a span of about 40 years of contact with the organic field, it provides a very satisfactory summation, not only of present status, but of the development over that period of evidences that add up to far more precise current conceptions of basic aromatic structures and behaviors. For example, evidences, among others, include bond distances, energies, angles, resonance energies, dipole moments, substituent constants, and the like. In studying the details of this book, I was reminded of a truism current in my academic days to the effect that, while hypothesis, theory, and terminology may change, sound basic concepts and soundly taken data stand. Although concepts and theory of a generation ago have undergone some modifications and a great deal has been done, through quantitative evidence, to sharpen precision of concepts, the greater change seems to be in terminology, including its expansion. A sample list from this book might include: electronic affinity, electronic symmetry, electronic "sink," electron density, redox potential, mesmeric effect, inductive effect, dynamic tautomerism, orbitals, resonance energy, both positive and negative, benzologues, π-electrons, canonical set, triagonal, positive charge, steric hindrance, reactivity, affinity, and aromaticity. Some of these are older friends than others.

As should be evident at this point, my appraisal is favorable, and the book is strongly recommended.

RALPH L. BROWN

U.S. Bureau of Mines

Abnormal and Pathological Plant Growth. Report of symposium held 3–5 Aug. 1953. Brookhaven National Laboratory, Upton, N. Y., 1954. (Order from Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C.). vii + 303 pp. Illus. Paper, $2.10.

This 300-page volume consists of 16 chapters, each on a different phase of abnormal plant growth, as presented by outstanding scientists in their special fields. The 213 figures and 32 tables are invaluable in presenting accurate conceptions of gross abnormalities on many species of plants. A few papers include detailed photomicrographs of virus material, magnified up to 30,000 times, which cause a certain type of plant enlargement. Splendid microscopic sections portray the structure of these weird overgrowths.

After reading this book one realizes more fully that there are numerous factors or agents that induce abnormal plant growth. These vary from physical agents, such as heat or radiations, to a wide range of chemical and biological stimuli. These various kinds of abnormalities, in turn, are scrutinized and studied under diverse disciplines, such as genetics, physiology, and morphology.

It is doubtful that any previous volume approaches this one for such complete coverage of plant abnormalities. Each paper gives a comprehensive review of the research done on the various types of plant overgrowths, whether genetic, bacterial, virus, or chemical. In addition to the summary following each paper, there is a discussion of the subject matter in the form of questions, answers, and comments. Also, the bibliography accompanying each paper is very extensive and complete.

The legume root nodule, which has intrigued botanists for centuries, is summarized completely under many headings, covering all stages of development. The same is true for most of the topics presented.

This book should make a tremendous impression on all those interested in this special phase of biology.

Students of botany will find it extremely useful because of the complete bibliographies, as well as the interesting discussions on the general subject matter. All articles are presented in technical language, and their use will be largely restricted to students or at least to those with a broad background in biology.

These papers give a clear understanding of abnormalities in plants, together with factors that are known to cause them. Some portions suggest how plant tissues may be stimulated and how they may be retarded. Perchance the basic laws that apply to tissue stimulation eventually can be used in controlled stimulation of a desirable kind. With a better understanding of plant tissue stimulation, perhaps this knowledge can be applied to abnormalities in animal tissues so that more control can be applied to human maladies.

This symposium had as its purpose the assembling of information about abnormal plant growth so that others might be informed and stimulated to carry on in this important branch of research.

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Elsevier's Encyclopaedia of Organic Chemistry. ser. III: *Carboisocyclic compounds*; vol. 12B: *Naphthalene,* A. Compounds containing one naphthalene nucleus. F. Radt, Ed. Elsevier, Amsterdam–Houston, 1953. xlxiii + 703 pp. $66 (ser. subscr. $58; complete subscr. $50).

The formidable cost of "Elsevier" has perhaps persuaded many people that "another Beilstein" was too much of a luxury, even though it offered the convenience of being written in English. I hope this review may convince a few such people that "Elsevier" has so much to offer that technical libraries cannot properly consider themselves adequate without it.

The extremely thorough literature coverage of the newest volume is complete through 1944, with additional structural data up to 1953. The information given is surprisingly detailed, lucid, and easy to follow. The needs of the scientist in fields peripheral to organic chemistry have been well attended to, both in the individual entries and in the index. The inclusion of several topic listings (such as "Growth promoting substances," under which each pertinent substance is listed with its page reference) should endear this work to the biologist and the applied chemist.

The unusual arrangement, wherein compounds of similar carbon skeleton are grouped together, regardless of the degree of saturation, and functional group subdivisions are subordinate to the broad division by skeletal types, is a more useful innovation than might at first appear. The great saving of the user's time, effected by having the most logically related compounds grouped together, should in a few years nearly pay the entire cost of the series for an industrial library.

The nomenclature is a delight; the compilers seem to have intuitively picked the names that the practicing organic chemist would use. Alternative names are given where necessary. Random checks of the accuracy and completeness of this work have evoked my admiration for the compilers' zeal. The literature has been abstracted with a most careful precision, and nothing pertinent seems to have been omitted.

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Index IX to the Literature of American Economic Entomology. Jan. 1, 1948–Dec. 31, 1949. Ina L. Hawes, compiler. Entomological Society of America, 1530 P St., NW, Washington 5, D.C., 1954. 528 pp. $3.50.

This book is the latest issue of a series that has a venerable and distinguished history. The need for a reference work of this kind for the entomological profession was realized as long ago as 1882, at which time publication was authorized by the U.S. Congress of a *Bibliography of Economic Entomology,* parts 1 to 3 inclusive, 1860–1886, to be prepared later by B. Pickman Mann and Samuel Henshaw. This work, when finally published in 1890, was a 454-page, octavo, cloth-bound volume, carefully indexed, and limited in scope to a bibliography of the entomological writings of the noted entomologists Benjamin Dana Walsh and Charles Valentine Riley. Later, this was followed by parts 4 to 8, inclusive, with a total of 751 pages, uniform with the preceding, compiled by Henshaw and Nathan Banks, published by the Congress in 1895, 1896, 1898, and 1901, and covering all the more important contributions to American economic entomology down to the beginning of the calendar year 1905. Issued in very small edition, all these extremely useful volumes were soon completely out of print, and for many years each of them has been a collector's item.

Subsequent to 1 Jan. 1905, the cost of publication of this series, no longer borne by the Congress, was assumed by the American Association of Economic Entomologists, and the volumes were issued at irregular intervals under the title of *Index of American Economic Entomology,* and as numbered special publications. The first of these covered the years 1905–1914, in octavo cloth binding, was compiled by Banks and was issued in 1917. Indexes II to VI covered the years 1915–19, 1920–24, 1925–29, 1930–34, and 1935–39 and were compiled by Mabel Colcord. Index VII and subsequent issues have been compiled by Ina L. Hawes, assisted at various times by W. H. Mitchell, Ethel L. Coons, Alice Renk, S. W. Bromley, and others.

Beginning with Index VII, it became necessary to enlarge the geographic scope of the series to comprise continental North America, including Canada, Alaska, Mexico, Panama Canal Zone, Cuba, Puerto Rico, Hawaii, and certain other Pacific islands, particularly those that played a part in World War II. It also became desirable that the common names of insects be used, as approved by the Committee on Common Names of Insects. Index VII covers the years 1940–44; Index VIII, 1945–47; Index IX, 1948–49;

Index X, 1950; Index XI, 1951; and Index XII, when issued, 1952. Owing to nonconsecutive dates of publication of the recent volumes, it should be noted that this volume fills the gap between Index VIII and Index X and that the series, which was placed on an annual basis with Index X, 1950, is now complete through 1951.

In view of the fact that this Index covers in minute detail a field not fully or adequately covered elsewhere, it would be a matter of difficulty to attempt to evaluate its great and outstanding usefulness to the research workers within the scope of its subject matter. Particularly, would such be true with regard to those who must keep up with the most recent periodical literature dealing with down-to-the-minute work on such subjects as the newer insecticides, latest approved methods for their application, or, perhaps, latest results obtained from tests of new compounds. Indeed, so rapid have been developments along some of these lines that it becomes of deep interest merely to note something of the extent to which investigation has been broadened from volume to volume in the use of new words, representing names of new compounds, new subject headings, new types of equipment, and the like. These additions to the vocabulary represent definite milestones in advancement of our knowledge and, when traced from volume to volume, are eloquent in dramatizing progress.

An average person probably would consider a reference work of this kind as exceedingly uninteresting reading. However, when approached with imagination and insight, these volumes tell a vivid, dramatic story. Dull looking as they may appear, they represent detailed documentation, item by item, of year by year advancement of an army of skilled workers in the control of insect enemies of sufficient importance that they vitally effect the geographic distribution, the food supply, the health, and the general welfare of millions of people over the world.

J. S. WADE

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The Psychiatric Interview. Harry Stack Sullivan. Helen Swick Perry and Mary Ladd Gawel, Eds. Norton, New York, 1954. xxiii + 246 pp. $4.50.

The death in 1949 of Harry Stack Sullivan prematurely ended the career of one of psychoanalysis' most brilliant and controversial figures. Since he left only one book, it is fortunate that his coworkers have put forth the effort to edit several series of his lectures and make them available in book form. This volume includes lectures given in 1944 and 1945 in which Sullivan applied his particular interest in the problems of communication to a specific consideration of the interview. Its informal style reveals his personality, his sometimes sardonic humor, and his characteristic method of teaching.

The book is a readable guide to Sullivan's concept of the theoretical nature and practical technique of the interview. He first makes it clear that an interviewer must contribute thought and direction, as well as a sympathetic ear, to carry out his responsibilities. He then outlines the objectives of the interview and emphasizes the specific maneuvers he used to accomplish these objectives.

His lucid and practical discussion should be helpful to the psychiatrist, particularly the psychiatrist in training. However, whether the material is equally helpful to ministers, educators, and workers in industry, as recommended by the author, is open to some question, unless they have an unusually extensive psychiatric background.

Sullivan's book demonstrates that psychoanalysis today is by no means limited to Freudian theory. He was a leader in the challenge to those who tended to look on Freud as a final authority, and he contributed materially to the scientific advance of psychoanalysis and to the prevention of its stagnation. The taste of Sullivan's dynamic thinking included in *The Psychiatric Interview* should stimulate the reader to further exploration of his interpersonal theory of psychiatry.

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How to Understand Propaganda. Alfred McClung Lee. Rinehart, New York, 1952 (reissue, 1954). xii + 281 pp. $3.

It is encouraging to hear again, even if indirectly, from the Institute for Propaganda Analysis, which voluntarily ceased its work at the start of World War II. Alfred McClung Lee served for a period as executive director of that important organization and has had a long, unbroken interest in propaganda. This book is a reorganization and popular interpretation of Lee's writings in learned journals during a period of two decades. It should be viewed, therefore, as a popularization rather than as a work pushing forward the frontiers of thought and research in this field.

The early pioneer work of the Institute for Propaganda Analysis was concerned principally with large-scale national propagandas. Indeed it was this very emphasis that led to the dilemma of loyalty created by our own entrance into war—a dilemma which the Institute patriotically resolved by ceasing its work. *How to Understand Propaganda* is directed more at domestic forces, commercial advertising, vicious brands of super-patriotism, and other compulsions that place us under what the author calls "the growing pall of orthodoxy." He seeks to reinforce the objectives of liberal education by helping man free himself from the glue of mass opinion and conformity that has been slowly poured over him. He reflects the same concern for individuality that occupied much of the energy of Thoreau and Mill and, in our own time, of Ortega y Gasset in his *Revolt of the Masses* and David Riesman in *The Lonely Crowd.*

Lee's analysis, however, lacks the clarity and incisiveness of these other works. It is true that his warnings about the development of mass man are put

in a modern context, but the dangers are ancient, and the real solution is as ancient as the dangers. It is questionable whether a new dimension of analysis or a new insight is contributed by the present work. It would be difficult, for example, to improve on Mill's admonition:

> Precisely because tyranny of opinion is such as to make eccentricity a reproach, it is desirable, in order to break through that tyranny, that people should be eccentric. . . . That so few dare to be eccentric marks the chief danger of the time. [Mill, *On Liberty*, chapter entitled "Of individuality."]

Lee's first suggestion for combating the effects of propaganda is that "we must give up certainty." For, he states, "in a world in which all is relative to all else and in which all is constantly changing, there is no certainty, no valid absolute or dogma." Some of the staunchest defenders of freedom in our day would not agree with this assumption. Certainly, for example, responsible British conservatives in the tradition of Burke would be the first to believe in certain absolutes concerning the dignity of man and the existence of natural law; yet they would also be the first to defend individuality and eccentricity within the circle of these absolutes. All of which is simply saying that the maintenance of individuality does not really depend upon the denial of certainty "in all things" but rather upon the questioning of certainty in most things. There will be sharp disagreement about this first assumption of liberty. But at least Lee has reminded us of the need for asserting independence and thinking for ourselves. This should help us to escape the pall of uniformity that he decries.

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Atlas of Men. A guide for somatotyping the adult male at all ages. William H. Sheldon. Harper, New York, 1954. xvi + 357 pp. Illus. $10.

This *Atlas of Men*, by William H. Sheldon and two listed collaborators, is the fourth book to appear in the inevitably controversial "Constitutional Psychology" Series. For the record, it is outsize and handsomely printed. It provides 1:30 body-build photographs of 1175 men selected from a master file of 46,000, and age-height-weight norms for each of the 88 known somatotypes. In addition, there is a prose accompaniment: verbal and graphic sketches of birds, insects, and mammals (both living and extinct); observations on diverse topics; an estimate of the probable somatotype of Abraham Lincoln (1½–6–3); and some commentary on Babe Ruth's lower legs.

Age-weight-height norms for each somatotype represent an interesting and potentially useful contribution. So, too, is the evidence that for most somatotypes, gross weight decreases by the late fifties, suggesting possibly differential survival *within each somatotype*. However, statistically sophisticated workers may object that 46,000 cases (two-thirds of them from college campuses) are too few for 88 somatotypes, 15 stature groups, and 8 to 10 age groups, or 13,200 categories in all! Thus, while the information for the 7–1–1, incidence 1 per 10,000, is based on only 4 or 5 men, there are 75 weight-for-age-and-height norms given for this rare somatotype! Sheldon explains that "in the cases of somatotypes of extreme rarity the weight data are derived *mainly* by interpolation" (p. 31), which is a most unpretentious way of describing the methods used in computing the "norms."

As readers of the previous volumes know, the three-number system may be augmented by more verbal descriptions. A 4–5–1 can be called an endomorphic mesomorph or a Northwesterner (referring to its position on the somatotype triangle). In this *Atlas*, Sheldon, responding to no popular demand whatsoever, likens each of the 88 somatotypes to a different bird, insect, or mammal—1–1–7's are "wasps," 1–7–2's are "eagles," 3–2–5's are "railbirds," 3–5–4's are "racehorses," and 6–2–1's are "seals" or "platypuses." Impartially, the animals, as well as the men, come in for description and portrayal but in the form of miniature line cuts and not in the expected three views.

In certain respects Sheldon has moderated, or mellowed. Neither sociologists nor razor blade manufacturers will find personal affront in the *Atlas*. In considering the idea of specific organ weaknesses, cross-cutting somatotypical lines, Sheldon comes closer to Julius Bauer. He adheres more closely to contemporary thinking by suggesting that morbidity (and probably) mortality might be reduced if most somatotypes were trained down to 10 percent below their norm-for-somatotype weights. (In the case of the 7–3–1 this still leaves about 200 lb of fat.)

Yet these concessions do not entirely remove the impression of increasing isolationism. Rarely are other studies utilizing the somatotype approach mentioned, even when conducted by C. W. Dupertuis, who is listed on the title page as a collaborator. Hooton's modification of the Sheldon system is ignored, even though extensively applied to Army separatees. Tanner's work in England, extensive work in Scandinavia, several studies from South Africa, in fact the factor analyses of Burt, Howells, and others, even the work of Morris—none achieve acknowledgment. Kraus (who somatotyped Japanese) is never mentioned by name, nor is Gallagher, Bodell, or Seltzer. And the whole question of why there should be correlations between physique and disease, normal or psychotic behavior, or anything is avoided or dealt with mechanistically, when there is increasing evidence that body form and biochemical function are not unrelated dimensions and when Sheldon stresses the desirability of reasonable (but unspecified) biochemical tests.

Because Sheldon's writings always elicit a strikingly bimodal response with individuals on the tails loudest in their praise or condemnation, it is hardly possible to review the *Atlas* in the conventional way. If you are for Sheldon or at least interested in descriptive somatotyping you will find in the *Atlas* multiple ex-

amples of each somatotype, at various ages, plus the age-weight-height data mentioned. If you are against the man or his system, then the college-weighted sample, the subjective though reproducible ratings, the attempt to provide norms with inadequate material, and the tasteless zoo approach may elicit a dangerous cardiac response.

Either way, you will not find a definition of the somatotype other than something between the phenotype or the genotype, nor direct information bearing on the permanence of the somatotype, nor proof that an endopene or an endomorph is not simply an individual habituated to markedly different patterns of food consumption and energy expenditure.

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Anatomy of Weeds. Emil Korsmo. Grondahl, Oslo, 1954. 413 pp. Illus. Kr. 100.

Emil Korsmo terminates his lifework in the field of weed biology by publishing this book containing anatomical descriptions of 95 weed species with 2050 original drawings. The anatomical structure of the stem, leaf, and underground parts is illustrated and described for each species. In addition, a short description is given of the external morphology of the plant, together with its means of multiplication and dispersal and its distribution.

Almost all the 95 species included are present as weeds in the agricultural areas of northeastern North America. Of those weeds classified as "primary noxious" under the Seeds Act of Canada or of the State of Indiana, at least two-thirds of them are treated in this volume. It illustrates and describes the anatomy of 25 of the 94 species contained in *Some Important Michigan Weeds* [Special Bull. 304, Michigan State College (1951)], and of 26 of the 165 species contained in *South Dakota Weeds* [South Dakota State Weed Board Pub. 5 (1950)].

Folio in size, the book is printed in English on coated paper stock. The text is well-written and the plates are very well reproduced. Korsmo is to be congratulated for compiling this information on plant anatomy, and it will be of real value to all workers dealing with weeds.

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The Compleat Strategyst. Being a primer on the theory of games of strategy. J. D. Williams. McGraw-Hill, New York–London, 1954. xiii + 234 pp. Illus. $4.75.

In this book the theory of games of strategy, applied to two-person games, has found an unsurpassed popular exposition. The author is chief of the mathematics division of the Rand Corp., which has done a formidable amount of research on most branches of game theory and its applications, primarily to military problems. He is therefore writing from the basis of unique experience; but in addition he brings unusual abilities to bear on his task, which is to give a simple, accurate account of a difficult theory.

The two-person situation, characterized by a conflict in the interests of the two parties (not necessarily individuals), is basic for the understanding of game theory. In this book it is explained in its many facets with great clarity. The fundamental concepts of the theory, such as saddlepoints, pure and mixed strategies, payoffs, value of a game, and so forth, are all presented in such fasion that a reader willing to do a moderate amount of thinking and to use elementary arithmetic (not more!) can get a good grasp of these notions. This is accomplished by means of interesting illustrations that are aptly used, often in a very humerous manner; they are further enlivened by the excellent cartoons of Charles Satterfield. The author shows the wide diversity of situations to which game theory applies, be in the Russian duel, the dissolution of a firm, the question of when to present flowers to your wife, or the deployment of troops on several mountain passes when the enemy's dispositions are unknown. References to linear programming and to nonzero-sum games (that is, where both sides may win or lose) conclude the work.

The reader, having followed the author on a not-very-thorny path, should be able to go beyond the illustrations offered and to apply the theory to problems of his own experience. If there are prizes awarded for successful popularization of scientific theories, this book should be a serious candidate.

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Linear Analysis. Measure and integral, Banach and Hilbert space, linear integral equations. Adriaan Cornelis Zaanen. North-Holland, Amsterdam; Interscience, New York, 1953. 600 pp. $11.

This book does two things and does them very well indeed. It gives a comprehensive account, from first principles, of the basic theory of both Banach and Hilbert spaces. It also presents, as illustration and application, a thorough treatment of linear integral transformations having a compact iterate.

In order to have significant examples at all stages of the argument, the author begins (part I, 5 chaps., 87 pp.) with a discussion of measure and integration suited to his purposes. Familiar definitions of exterior measure and measurable set are given and specialized to yield Lebesgue measure if $X = R_m$ (Euclidean m-space) and, in a different way, Stieltjes measure if $X = R_1$. Measurable functions, product-measures, and an integral (via ordinate sets) are discussed, the development is carried through Fubini's theorem. A brief treatment of additive set functions culminates in the Radon-Nikodym theorem. The final chapter develops the basic theory of the Lebesgue spaces $L_p (1 \leq p \leq \infty)$ and the Orliez spaces L_ϕ. Although

there are no references, the material being largely classical, the preface acknowledges the influence of De Bruijn's lecture notes and the books of Halmos and Saks.

Part II (7 chaps., 364 pp.), the meat of the book, is devoted to "Bounded transformations and compact transformations in Banach space and Hilbert space." Except for the terse survey of Banach spaces in the early part of Hille's *Colloquium Lectures*, there has been no detailed treatment of either Banach or Hilbert space since the treatises of Banach and Stone in 1932. The attractive development given here will be valuable as a textbook for students and as a standard reference for the expert. The reader is referred to the monographs of Nagy and Halmos for detailed discussion of more general transformations in Hilbert space.

To begin with, the rudimentary properties of Banach and Hilbert spaces are proved and illustrated. Separability is usually not assumed, and there are several results in which completeness of the space is not assumed.

In the treatment (chap. 7) of bounded linear transformations, the theorem (Ext.) on extension of bounded linear functionals is basic. This theorem can be proved in a separable Banach space or in a Hilbert space without appealing to the Axiom of Choice. Here the author renounces the Axiom of Choice entirely, and assumes Ext., when needed, as a further postulate. The discussion includes results on the first and second adjoint spaces, weak convergence, closed transformations, the adjoint transformation, and projections.

A concise algebraic account of finite-dimensional spaces is carried through the Hamilton-Cayley theorem and the (Jordan) canonical form.

Chapter 9 is devoted principally to bounded self-adjoint transformations in Hilbert space. One also finds here a substantial introductory discussion of linear integral transformations. The latter part of the chapter discusses symmetrizable and normal transformations and closes with a presentation, following F. Smithies, of the Fredholm theory for a linear transformation T of a separable Hilbert space into itself such that $\Sigma_{ij} | (T\varphi_i, \varphi_j) |^2 < \infty$, where φ_j is a complete orthonormal system.

Next the author studies the range, nullspace, and spectral properties of bounded linear transformations on one Banach space into another, extending the results on these topics given in earlier chapters.

The long Chapter 11 treats compact transformations on one Banach space into another. A transformation is compact (formerly "completely continuous") if the map of bounded set has a compact closure. One misses here at least some mention of approximating a compact transformation by a transformation with finite-dimensional range. The Riesz-Schauder theory is given for a transformation T with a compact iterate. Further results in Hilbert space are presented, and the chapter closes with two mean ergodic theorems.

The final chapter of part II is devoted to compact symmetrizable, self-adjoint, and normal transformations in Hilbert space. The emphasis is on spectral properties, and the minimax relations and expansion theorems are developed in detail.

Part III (5 chaps., 136 pp.), entitled "Nonsingular linear integral equations," will be of particular interest to specialists in that branch of analysis. Roughly half the space is devoted to general theory (spectral properties, resolvent, expansion theorems, and so forth), with numerous applications of the material developed in part II. Remaining chapters treat normal kernels, symmetrizable kernels, and kernels of Marty, Garbe, and Pell. Although the original contributions of the author in part II are substantial, in part III they are very conspicuous, and his treatment clearly indicates the progress that has been made since the initial work on these particular questions.

The general theory of linear topologic spaces is omitted, along with non-linear and unbounded linear transformations.

By concentrating on his chosen objectives, however, Zaanen has been able to dispose of them in an unusually thorough way. The book is enriched with numerous examples and much illuminating comment. Many chapters are followed by long lists of valuable exercises with generous hints. The few typographic errors noted are trivial. This book is meticulously written, at a very high level of explicitness, and the prerequisites are so modest that an intermediate graduate student should be able to use it with little assistance. The author has met in a very satisfying way an urgent need in the expository literature.

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The Statistical Approach to X-ray Structure Analysis. Vladimir Vand and Ray Pepinsky. Pennsylvania State Univ., State College, Pa., 1953. xvi + 98 pp. Illus. Paper, $1.50.

A proper solution to the phase problem of x-ray crystal structure analysis—that is, the problem of somehow supplying the phases of the Fourier coefficients of a crystal structure to accompany the experimentally measurable magnitudes—would be an achievement of the highest importance, for it would make the complete and precise structure determination of every crystallizable substance a routine matter. Only a few months ago a monograph appeared [*The Solution of the Phase Problem*, pt. I, *The Centrosymmetric Crystal*. H. Hauptmann and J. Karle, American Crystallographic Assoc. Monogr. No. 3. The Letter Shop, Wilmington, Del. (1953)] that seemed to provide this long-sought solution. Hauptmann and Karle's method is a statistical one; they take advantage of the fact that there are more magnitudes known than are strictly necessary to characterize the structure to obtain the most probable value for each of the phases.

Almost immediately objections were raised, and they have found their strongest statement in the pres-

ent monograph by Vand and Pepinsky. These authors agree that, except for certain approximations that are probably of little importance, Hauptmann and Karle's derivation is correct. But they claim that the most probable phases will not always be the true phases and, moreover, that the discrepancies will not be random but systematic and of such nature as to produce in general an incorrect structure, resembling the Patterson function (self-convolution) of the structure more than the structure itself. In a simple case that they present this is indeed what happens, but their case may be too simple to meet the basic requirements of any statistical method.

The controversy is by no means settled yet. But such a controversy, if pursued in good spirit, can benefit the science greatly. Vand and Pepinsky's monograph is a case in point. They have presented their case admirably, and they have put forward a considerable number of new ideas.

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Mammalian Hybrids. A check-list with bibliography. Annie P. Gray. Commonwealth Agricultural Bureaux, Bucks, Eng., 1954. 144 pp. 21s.

This annotated compilation of records of hybridization of mammals lists more than 300 cases, a surprising number. It is also surprising how many of these hybrids have been fertile.

A bibliography of more than 600 titles and an excellent index are included. There are interesting notes on behavior, fertility, and physical characters.

Naturally, in a work of this sort there are a number of omissions, but this book will be welcomed by biologists, especially those interested in mammalian genetics, as a reference and as a guide.

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Autotrophic Micro-organisms. Fourth Symposium of the Society for General Microbiology held in April 1954. B. A. Fry and J. L. Peel, Eds. Cambridge Univ. Press, New York, 1954. ix + 305 pp. Illus. $5.

In the beginning there must be synthesis. Autotrophic microorganisms are independent of the more elaborate forms of carbon compounds, being able to live and multiply in an environment containing carbon dioxide as the sole source of carbon. Many organisms may live autotrophically—others have to. In this book a group of scientists from Britain, the U.S.A., Norway, and Holland record the discussion at a meeting in London regarding the physiology, biochemistry, metabolism, production, and economic importance of these organisms. Early chapters simplify the nomenclature, describe connections with other types of organisms, and show that although simple in the nutritional sense the autotrophs have a greater range of biochemical accomplishment than any other living creatures. Later chapters delineate present knowledge of these simple and mainly aquatic bacteria and algae and indicate many possibilities for the development of this knowledge in the future. Thiobacilli, nitrifying bacteria, blue-green algae, photosynthesis, the utilization of organic compounds, and energy relationships are dealt with in turn.

The economic importance of the autotrophs is discussed in the final chapter. By accumulation of chemical energy by the phytoplankton (photoautotrophs), by the nutrition of higher green plants, by improvement of eroded soils, by sewage disposal, by increasing the yield of fish, or by the production of sulfur, they can or may in the future be of great use. Destructive effects such as corrosion of iron, ships, rubber, and cement, and the occasional mass mortality of fish, are dealt with.

This is a valuable collection of data for workers in this field. Its interest to others arises both because of the substantial conformity that these microorganisms show in their metabolic pattern with all forms of life and because of the occasional striking biochemical differences that are present. The book, well produced and well written, has accomplished its aim of providing an account of the present position in this expanding field of knowledge.

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Elements of Food Engineering. vol. II: *Unit Operations.* Milton E. Parker. With the collaboration of Ellery H. Harvey and E. S. Stateler. Reinhold, New York, 1954. vi + 360 pp. Illus. $8.50.

This is the second volume of a three-volume series. In the first volume, published in 1952, the authors described different classes of refined food products and *what* is usually done in the way of processing to produce the product. Processing equipment was only incidentally mentioned. This second volume places more emphasis on *how* the processing is done.

The 10 chapters (chapters 14–23) in this volume cover unit operations concerned with assembly, preparation, and conversion of raw materials. The book is profusely illustrated with pictures and diagrams showing typical equipment and processing layouts for operations in a diversified group of food industries. For example, the cleaning of raw materials is illustrated by pictures and diagrams covering gyrosifters, Entoleters, spinach dry cleaners, automatic bottle cleaners, hydraulic scrubbing equipment, whirlpool washers, air purifiers, filters, clarifiers, and so forth. The treatment is descriptive rather than critical.

The authors have assembled a large and diversified list of standard pieces of food processing equipment, along with descriptions of how each fits into normal commercial operations. This should provide undergraduate students of food technology with an excellent introduction to the broad scope of food process-

ing and acquaint them with the types of standard commercial equipment available to carry on the different elements of processing in the many special areas of the food industries.

This is not an engineering textbook in the usual sense but a descriptive introduction to food processing. Since it attempts to cover everything from washing spinach and dehairing hogs to freezing and canning in a total of 347 pages, there can be no exhaustive treatment of any of these operations. However, because so many engineering students have little or no acquaintance with food processing, this book should provide them with a needed general view of the types of operations and, in particular, the kind of equipment normally used in the food industries. The information is sufficient to indicate the principles involved in the handling of food products as differenitated from other materials.

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Heat Transmission. William H. McAdams. McGraw-Hill, New York–London, ed. 3, 1954. xiv + 532 pp. Illus. $8.50.

The third edition of this outstanding textbook and reference book reflects the progress made in the area of heat transmission since the publication of its predecessor 12 years ago. New information and data have been added to provide an up-to-date presentation of practically all phases of heat transfer that are of interest to practicing engineers, scientists, and students. The book provides a critical review of much of the existing experimental data, thereby relieving the design engineer of comparing and evaluating data from several sources.

The general modes of heat transfers, conduction, radiation, and convection are covered in 15 chapters. The chapter titles are "Introduction to heat transmission," "Steady conduction," "Transient conduction," "Radiant-heat transmission," "Dimensional analysis," "Flow of fluids," "Natural convection," "Introduction to forced convection," "Heating and cooling inside tubes," "Heating and cooling outside tubes," "Compact exchangers," "High-velocity flow," "Condensing vapors," "Boiling liquids," and "Applications to design." Many useful tables and charts are included in the appendix. An extensive and important bibliography and author index are presented for each chapter.

One of the significant modifications in the third edition is a revision of the chapter, "Radiant-heat transmission," which was prepared by H. C. Hottel. New charts have been included for evaluating the emissivity in the section on gas radiation. The carbon dioxide and water vapor charts have been expanded to allow the engineer to estimate the gas radiation at temperatures encountered in rocket work. A new generalized procedure based on the use of determinants has been incorporated to cover the case of radiant energy exchange in a multisurface gray enclosure containing a nongray absorbing and emitting gas.

Another new feature of the third edition is the addition of chapters entitled "Natural convection," "Compact exchangers—packed and fluidized systems," and "High-velocity flow; rarefied gases." Much of the material in the latter two chapters was heretofore available only in scattered technical publications.

This is an authoritative treatment of the field of heat transfer and is highly recommended for engineers and scientists who are engaged in analyzing problems in this area of engineering.

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Technical Papers

Nuclear Volume and Testosterone-Induced Changes in Secretory Activity in the Submaxillary Gland of Mice

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The secretory activity of the tubular portion of the submaxillary gland in mice is stimulated by androgens (*1*), and it has been demonstrated that this is correlated with a significant increase in the volume of the nucleus (*2*). These findings favor the view that the nuclear volume is related to the secretory activity of the cell (*3*).

Junqueira (*4*), Rabinovitch (*5*), and Fernandes and Junqueira (*6*) have shown that ligature of the excretory duct induces a considerable diminution of the secretory activity of the cells. The glands, however, do not degenerate and are able to respond in the normal way to stimulation by testosterone. Such findings offer new approaches to the study of nuclear phenomena as related to cell secretion, since they permit control of the secretory activity of the cells.

Male white mice were used in the present study. The ducts of the right submaxillary glands were ligated, the left glands serving as controls. In a first set of experiments, 20 mg of testosterone propionate in powder form was implanted under the skin of adult mice 30 days after the ligature of the excretory ducts. Control animals were submitted to the same operation, the implantation of the drug being omitted. The animals were killed 15 days later, and the submaxillary glands were removed and fixed 6 hr in Helly's fluid. In a second set of experiments, immature animals weighing 15 g were castrated, the right submaxillary glands

Table 1. Nuclear volumes (μ^3) of the tubular portion of the submaxillary gland of mice. The numbers in each section refer to nuclear volume and standard error of the mean. The numbers of the nuclei measured are given in parentheses.

Untreated animals		Testosterone propionate-treated animals	
Control gland	Duct-ligated gland	Control gland	Duct-ligated gland
Adult male mice (Set I)			
101,1 ± 2,2 (110)	91,5 ± 2,4 (112)	103,0 ± 2,0 (104)	106,2 ± 2,1 (119)
86,2 ± 2,5 (127)	73,7 ± 3,2 (126)	109,2 ± 2,4 (125)	105,8 ± 2,2 (116)
92,9 ± 1,9 (128)	92,0 ± 2,0 (138)	132,4 ± 3,2 (116)	97,2 ± 2,1 (147)
82,6 ± 2,7 (118)	68,1 ± 3,8 (110)	119,0 ± 2,6 (108)	128,4 ± 3,0 (92)
82,0 ± 2,8 (105)	72,7 ± 3,0 (107)	101,6 ± 2,0 (110)	101,5 ± 2,2 (110)
88,3 ± 2,2 (113)	69,8 ± 3,3 (133)		
89,8*	78,2*	113,2*	106.4*
Castrated immature male mice (Set II)			
108,7 ± 2,1 (98)	93,5 ± 2,2 (100)	114,8 ± 3,4 (96)	136,1 ± 4,5 (97)
99,2 ± 2,2 (99)	78,2 ± 3,0 (99)	130,8 ± 2,8 (100)	125,0 ± 3,4 (101)
125,5 ± 3,3 (100)	105,6 ± 2,1 (100)	140,2 ± 4,6 (100)	134,7 ± 4,0 (100)
115,4 ± 2,5 (99)	102,1 ± 2,0 (105)	142,9 ± 5,2 (99)	152,9 ± 4,3 (99)
		129,0 ± 3,8 (100)	126,4 ± 3,2 (101)
112,3*	95,0*	131,7*	134,9*

* Weighted mean.

ligated, and on the following day 20 mg of testosterone propionate was implanted. In the control animals the hormone was omitted. The animals were killed 30 days later.

The nuclear volumes were measured on 15-μ thick sections stained by Feulgen's method. The nuclei were selected at random, their outlines were drawn at a magnification of 3350, and two perpendicular diameters were measured, according to the method of Olivo, Porta, and Barberis (*7*).

The volume V of the nucleus was calculated by means of the formula

$$V = \frac{\pi}{6} \times \left[\frac{D_1 + D_2}{2}\right]^3,$$

where D_1 and D_2 are the respective nuclear diameters.

The statistical analysis of the results was made after grouping the values in frequency classes with a class interval of 10 μ^3.

The tissues of animals used in each set of experiments were treated exactly in the same way. However, the two sets of experiments are not comparable, owing to difference in handling the specimens during the paraffin inclusion. Hence, the results of the two sets of experiments must be considered separately.

Table 1 shows, for individual animals, the mean nuclear volume in cubic microns, the standard error of the mean, and the number of nuclei measured.

Preliminary analysis of variance made in the conventional way revealed in both cases the existence of an interaction between testosterone and ligature. For this reason, the definitive analysis was made using the method of the unweighted means of Yates (*8*) for the case of a fourfold table. The following results were obtained.

1) Following testosterone propionate administration, a highly significant increase in the nuclear volumes is observed in both sets of experiments ($F = 859$ and $F = 553$). The F-values are the variance ratios, calculated according to the F-test of Snedecor (*9*).

2) The values of F for the "ligature" factor are also high and superior to the 1-percent level. This result indicates a statistically significant difference between the nuclear volumes of the ligated duct gland and these volumes in the control gland.

3) The F-value for the "interaction" factor is found to be significant in both sets of experiments. In the first case the F-value ($F = 4{,}6$) lies between the 1-percent and 5-percent level, and in the second one ($F = 66{,}3$) it is higher than the 1-percent probability level ($F_{1\ \text{percent}} = 6.6$, $F_{5\ \text{percent}} = 3.8$). This result leads to the conclusion that the responses of the intact and the ligated duct glands to the testosterone are significantly different. It is obvious that the ligated duct glands show more intense reactions.

The foregoing results indicated the desirability of a more accurate evaluation of the phenomena. For this reason separate variance analyses were made in both sets according to the methods indicated by Snedecor (*9*).

The results reveal the following: Without testosterone administration, the nuclear volume is significantly less in the ligated-duct glands than in the intact glands ($F = 19.98$ in the first set of experiments; $F = 88{,}5$ in the second set). Following testosterone administration, no significant difference could be observed between the glands ($F = 0.45$ in the first set of experiments, $F = 0.43$ in the second set).

Thus, the nuclei of the ligated-duct glands, although they are initially significantly smaller than the nuclei

of the intact glands, are able to respond to testosterone administration in such a way that the final volume is identical in both cases. This indicates that the diminution of the nuclear volume after ligature of the excretory duct is not the result of cellular degeneration, since the nuclei respond to the same extent to pharmacological stimulation. It may be admitted that this diminution is related to the lowering of secretory activity.

In conclusion, the present study (*10*) reveals that an increase in the size of the nuclei of the submaxillary gland occurs after stimulation of glandular activity induced by testosterone propionate administration. This has been observed in controls and in glands in which the excretory duct was ligated. Ligature of the excretory duct significantly reduces the nuclear volume. This diminution is not related to cellular degeneration and is attributed to the lowering of secretory activity by the interruption of the salivary flow.

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10. I wish to thank Harold Deutsch for the English translation and Lucien Lison for the assistance throughout the course of this investigation.

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Exudate of the Mushroom, *Polyporus dryadeus*

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Clear reddish-brown droplets of fluid appear on the surface of a large, flat basidiomycete, *Polyporus dryadeus* (*1*), although this exudate is not present under all conditions in the plant's life. The exudate attracted my interest (i) because of the copious rate of production of the clear fluid (tens of milliliters were readily collected by pipetting, and this was replaced by freshly formed exudate in a matter of hours), and (ii) because shallow but definite pits were present on the surface of the plant, where the pools of exudate had been sitting, which indicated that the fluid might have a fungilytic or fungicidal action.

The exudate is slightly acid, with a *p*H around 5. The material responsible for the reddish-brown color is almost completely precipitated by adding 5 vol of 95 percent ethanol to the original exudate; hardly any precipitation by alcohol takes place if the exudate is made slightly alkaline or more acid. The alcohol precipitate is not dissolved by petroleum ether or by carbon tetrachloride, but it does dissolve in ethyl ether. There is no precipitation upon addition of trichloracetic acid to the exudate. Boiling the original fluid, with or without the addition of strong NaOH, does not alter the color. Addition of 0.1 percent $FeCl_3$ solution to the almost colorless supernatant fluid (obtained after alcohol precipitation of the coloring matter) gives a strong yellow color test, suggesting the presence of organic acids (*2*). The color of the exudate changes with alterations of its *p*H, becoming a light yellow below about *p*H 4.5 and becoming a dark brown at about *p*H 7 and higher.

Pigmented substances have been found and identified in some related organisms. For example, "polyporic acid" (3,6-dihydroxy-2,5-diphenyl-4,4-benzoquinone) has been extracted from *P. nidulans* and *P. rutilans* (*3*). But, unlike "polyporic acid," the coloring matter in the exudate of *P. dryadeus* does not give a violet color with dilute ammonia, nor is it precipitated to any extent by HCl. It also appears to have distinctly different solubility properties from the colored substances in another preparation, "polyporin," which has been described by Bose (*4*) as a filtrate of a culture of *Polystictus sanguineus*. It seems improbable that the pigment in the exudate of *P. dryadeus* belongs to the group of "humins" that may result from autolytic tissue breakdown of proteins containing cyclic amino acids (*5*). The presence of the colored droplets on the surface of *P. dryadeus* seemed to precede rather than to follow the appearance of the pits underneath them. In contrast to the pigment under study, the humins are reported to become darker and to be precipitated in HCl and also to be precipitated by alcohol from an alkaline medium.

The collected exudate did not lose its clarity or undergo any obvious changes in color for months, even though it was collected and stored (at about 5°C) under nonsterile conditions and without the addition of any antibacterial agent. Although there have been reports of a lack of antibiotic activity by *P. dryadeus* against some bacteria (*Staphylococcus aureus* and *Escherichia coli*) (*6*), there was no mention of whether the exudate discussed in this paper was used in the test or was being produced by the plant at the time; and evidently no test of antifungal activity was attempted. Antifungal activity has been reported for another polypore, *P. biformis* (*7*).

Further purification of the pigment in the exudate of *P. dryadeus* and more adequate testing of it for antibiotic activity, especially for antifungal activity, would appear to be very desirable. Of additional interest is the question of the biological significance of the pitting or apparent degeneration of the mushroom's surface in response to its own exudate.

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1. I am indebted to L. Bonar and Ralph Emerson of the University of California, Berkeley, for identifying the organism. I also wish to thank E. Jorgensen of the College of Pharmacy, University of California, San Francisco, for consultation on some points in this paper.

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Cation-Induced Respiration in Barley Roots

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In the accumulation of salt against a diffusion gradient, the need for metabolic energy expenditure is patent, and some linkage must exist between the accumulation of salt and the energy-yielding process of respiration. In this connection, the observation has frequently been made that when inorganic salt is added to distilled water in which plant root tissue is respiring, there is an increase in the rate of O_2 uptake and CO_2 release. Lundegårdh (*1*) and Robertson *et al.* (*2*) have shown conclusively that the respiratory system involved is the cytochrome system. However, Lundegårdh's (*1, 3*) theoretical model linking the increased respiration with the absorption of *anions* only ("anion respiration") has been questioned (*4*). Recent investigations in this laboratory (*5, 6*) into the kinetics of ion absorption by excised barley roots have led to the conclusion that the absorption of *both* cations and anions involves intermediate compound formation between the ions and "binding compounds" or "carriers." These findings did not support the view that the mechanisms of cation and anion absorption differ in kind, in the manner assumed in the theory of anion respiration.

Synthetic ion exchangers bearing exchangeable mineral ions offer an opportunity of exposing plant roots to absorbable ions in the absence of absorbable ions of opposite sign. Overstreet and Jenny (*7*) and others have shown that mineral cations and anions adsorbed in exchangeable form are readily taken up by plant roots. This paper reports experiments (*8*) in which excised barley roots were exposed to cations adsorbed on synthetic weak-acid and strong-acid cation exchangers, and their effect on the rate of O_2 uptake by the tissue was measured.

The weak-acid exchanger was XE-97 (*9*). The acid form of the resin was titrated with KOH to give a suspension *p*H, at the final concentration used, of 8.0. The strong-acid exchanger used was the −400 mesh form of Dowex 50 (*10*). The K^+ form of the resin was prepared by treating it with excess KCl, followed by leaching with water until it was free from Cl^-. At the final concentration used, the suspension *p*H of K^+-Dowex 50 was 5.0.

Barley was germinated and grown in dilute Ca^{++} solutions, as described previously (*5*), with minor modifications. The barley variety used in the present experiments was Atlas 46. The uptake of O_2 by the excised roots was measured by means of conventional Warburg technique; 0.40 g (fresh weight) of roots was used in a final volume of 4.0 ml distilled water or suspension. The temperature was 24°C, and the shaking rate was 165 cy/min over an arc of 2 or 3 cm. The rate of oxygen diffusion was not limiting under these conditions, and the suspensions were vigorously agitated. All treatments were set up in triplicate or quadruplicate.

Figure 1 presents the results of a typical experiment with K^+-XE-97. Experiments with salts of monovalent ions, such as KCl or RbBr, give increases in the rate of O_2 uptake of approximately the same magnitude. The responses are similar in magnitude and time course to those obtained by Milthorpe and Robertson (*11*) for barley roots exposed to KCl. Exchanger saturated with H^+ ions (suspension *p*H 4.5) had no effect on the rate of O_2 uptake by the roots.

In the afore-described experiment, the suspension *p*H was 8.0, owing to hydrolysis of the cation on the weak-acid exchanger. A high *p*H, however, is not a prerequisite for the cation effect to be apparent. When roots were exposed to the K^+ form of the strong-acid cation exchanger, Dowex 50, suspension *p*H 5.0, similar effects were obtained, the only difference being that higher concentrations of K^+-Dowex 50 were required for a given response. At a K^+-Dowex 50 concentration of 200 milliequivalent per liter with respect to K^+, the magnitude of the respiratory response was the same as that obtained with K^+-XE-97 at 50 meq/lit.

The *p*H of the medium, however, is not without effect. When the weak-acid exchanger, XE-97, was titrated with Ca^{++} to a suspension *p*H of 8.0, a respiratory response was obtained which was essentially equal to that resulting from K^+-XE-97 at the

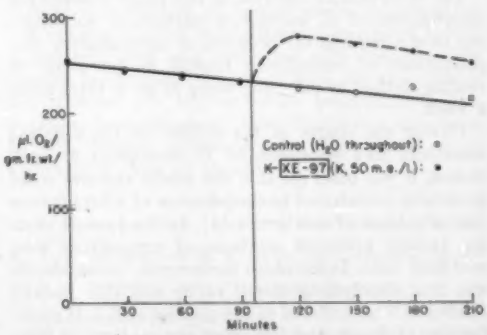

Fig. 1. Rate of O_2 uptake by excised barley roots: effect of tipping in a suspension of K^+-XE-97.

same *p*H. But Ca^{++}-Dowex 50, suspension *p*H 5.0, 200 meq/lit with respect to Ca^{++}, had no effect on the rate of O_2 uptake. The failure of Ca^{++} on the strong-acid exchanger, Dowex 50, to produce the effect is due, in part, to the smaller exchangeability of Ca^{++}, as compared with K^+, and is related, second, to the fact that Ca^{++} even as $CaCl_2$ gives rise to only a small and transient respiratory response. The results suggest that the cation-responsive system has a higher affinity for alkali cations than for the alkaline earths, and that the latter can be effective only upon removal of H^+-ion competition.

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Carbomycin, a Growth-Maintaining Factor for *Endameba histolytica* Cultures

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In vitro studies indicated that Magnamycin (carbomycin) had inhibitory effect on cultures of *Endameba histolytica* (*1*), and clinical trials showed that this antibiotic had a specific therapeutic effect in human amebiasis of the colon (*2*).

The observations reported in this paper concern the maintenance of *E. histolytica* cultures by subculturing once a week in the presence of subinhibitory concentrations of carbomycin instead of the usual or routine method of culturing every 48 hr or three times a week.

During the course of the studies on the acquired sensitivity and resistance of *E. histolytica* to antibiotics, it was observed that the ameba cultures could be serially maintained in the presence of subinhibitory concentrations of antibiotics (*3*). In the present studies, freshly prepared solutions of carbomycin were routinely used. Intravenous carbomycin hydrochloride was first dissolved in sterile saline and then serially diluted in 5 ml buffered saline overlay of N I H modification of Boeck and Drbohlov egg medium in 200-, 100-, 50-, and 25-μg/ml concentrations. Columbia strain of *E. histolytica* was selected for these initial experiments because it was a sturdy strain and had a tendency to develop resistance to antibiotics (*3*). It was serially grown in these four concentrations every 48 hr or three times a week. At the 24th subculture or generation, weekly transfers or subcultures were also started in 200-, 100-, 50-, and 25-μg/ml concentrations. At the time of the writing of the manuscript, the 48-hourly subcultures are in their 138th and the weekly subcultures are in their 40th generation or subculture.

In the 48-hourly transfers, the growth was very rich in all four concentrations, but about the 15th generation, it gradually became poor in 200 μg/ml, and about the 20th generation in 100 μg/ml concentration, nevertheless there was growth in the 138th generation. Although the growth was quite scanty, yet the amebas looked normal and were slightly undersized and sluggish. The growth in 50- and 25-μg/ml concentrations was in excellent condition in the 138th generation. A comparison of the ameba count in these concentrations with that of the stock Columbia strain showed a slight enhancement of growth, the trophozoites appeared healthier, were more actively motile, and had a tendency to be slightly larger.

The weekly transfers in 200-, 100-, 50-, and 25-μg/ml concentrations of carbomycin hydrochloride grew adequately until the 15th generation. The growth in 200 μg/ml became progressively poor from the 17th to 22nd generations and finally stopped. Similarly, the growth in 100-μg/ml concentration became quite poor at about the 26th generation and finally stopped in the 28th generation. In 50-μg/ml concentration the growth was quite satisfactory, and in 25-μg/ml concentration the growth was excellent, and there was a tendency for the trophozoites to be somewhat larger than the parent strain. An ameba count showed that the intensity of growth was almost the same as in the stock Columbia strain. At the 22nd generation, weekly subcultures were also started from 25-μg/ml weekly transfer culture, in 12.5- and 6.25-μg/ml concentrations. Presently, these subcultures are in their 14th generation. Although large numbers of trophozoites are still present, the growth is progressively getting poor.

Microscopic, macroscopic, and cultural studies of the bacterial flora of the weekly and thrice-weekly cultures with carbomycin showed no apparent variation from that of stock Columbia strain.

During the course of these experiments, subcultures from the experimental weekly and thrice-weekly cultures were serially grown in normal medium containing no antibiotic. Subcultures grew very well and did not differ from the parent stock Columbia strain, indicating that there was no carbomycin dependability.

Other strains of *E. histolytica* and other antibiotics are under investigation and will be reported at a later date.

In recent years, streptomycin-dependent strains of bacteria have been reported for *Mycobacterium tuberculosis, Neisseria meningitidis, Staphylococcus aureus, Proteus morganii, Pseudomonas aeruginosa, Klebsiella pneumoniae, Brucella melitensis, Bacillus subtilis,*

Escherichia coli, and *Salmonella typhi* (*4*). Apparently *E. histolytica* does not become carbomycin dependent, although in lower concentrations it enhances growth. There is no suppression of the accompanying bacterial flora in these cultures. Probably in very small quantities carbomycin appears to act as a growth-promoting or vitaminlike factor to *E. histolytica* cultures, or in subinhibitory concentrations, it inhibits or neutralizes some enzyme system or systems that induce autolysis of amebas.

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19 August 1954.

Benzotriazole, a Plant-Growth Regulator

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Benzotriazole causes distinctive morphological modifications in the tomato plant. The changes are characterized by breaking of apical dominance, reductions in the number of leaflets per leaf, elimination of leaf serrations, cupping of the leaflets, and extensive elongation of the petioles which are unable to support the weight of their own leaves (Fig. 1). The morphological changes are limited to the leaves that developed after the initiation of treatment. Denny (*1*) has previously reported that benzotriazole hastens the sprouting of dormant potatoes.

A formative effect was produced in tomatoes only when bezotriazole was applied to the roots. The Bonny Best variety of tomatoes (*Lycopersicon esculentum* Mill.) were grown in sand culture, supplemented with inorganic nutrient. When the plants were at the 6-leaf stage 50 ml of 50 ppm benzotriazole was applied daily for 10 consecutive days to the sand surrounding the roots. Within 2 to 3 wk after the final application of benzotriazole, formative effects developed. In contrast, concentrations as high as 1000 ppm benzotriazole applied to the foliage were without effect on tomato.

The similarity in structure between benzotriazole and indole or the purine bases suggests that benzotriazole may be a competitive antagonist of either of these organic nuclei vital in biological systems. Galston and Hand (*2*) have, in fact, demonstrated that adenine enhances the response of etiolated pea epicotyls to indoleacetic acid (IAA) and that benzimidazole, a

Fig. 1. (Top) Plants treated with benzotriazole (left), untreated (right). (Bottom) Stem of treated plant (left), untreated (right).

metabolic antagonist of adenine (*3*), partially inhibits the response to both IAA or adenine (*4*).

Attempts to reverse the effects of benzotriazole with daily applications of 50 ml of either 0.5 to 50 ppm of IAA or 250 ppm adenine sulfate were unsuccessful. IAA was applied in conjunction with benzotriazole, whereas adenine sulfate applications were started 10 days prior to, and continued until 8 days after, benzotriazole applications had ceased. Although adenine did not reverse the action of benzotriazole, other purine bases or some of their ribosides would be worthy of further investigation as benzotriazole antagonists.

A number of other unsubstituted 5-membered heterocycles, both free and condensed with benzene, were applied to the roots of tomato. With the exception of benzothiazole (*5*), neither indole, benzimidazole, benzoxazole, benzothiophene, benzothiadiazole, thiophene, pyrolle, thiazole, imidazole, nor 1,2,4-triazole caused a formative effect on tomato.

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Lysergic Acid Diethylamide (LSD 25): II. Psychobiological Effects on the Siamese Fighting Fish

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The striking effects following the oral administration of LSD 25 in man were first noted by Hofmann and described in detail by Stoll (*1*). These phenomena, which included both vegetative and psychotic responses, are described in detail elsewhere (*2*). Briefly, LSD 25 produces in man a schizophrenialike state lasting about 8 hr with doses of 50 to 100 μg by mouth. Because of the essentially psychic nature of the response that distinguishes LSD 25 from other ergot derivatives in the dosages employed, man has thus far been the best test animal.

It is the purpose of this paper (*3*) to show that the Siamese fighting fish exhibits vegetative, motor, and behavioral responses when administered solutions of LSD 25 in concentrations as low as 1 μg/ml dissolved in spring water. There is a quantitative difference between the responses of adult and juvenile fish. The juvenile *Betta* has thus far been the more sensitive of the two.

With fish approximately 1 in. in body length (snout to base of caudal fin rays) responses occur within minutes. The data in Table 1 were obtained by exposing groups of four fish each in glass vessels of uniform size containing 100 ml of the concentrations given in Table 1.

At the end of 6 hr, each group of fishes was dipped with a fish net five times in 100 ml of fresh spring water and then studied in glass jars containing 1 lit of spring water. The water was collected from a natural spring and permitted to stand 48 hr at room temperature before being used. Six hours after removal from the drug, the following observations were noted. The controls were normal. The remaining four groups exhibited the characteristic response of the juvenile fish, which may be listed as follows:

Table 1. Effect of concentration on the development and intensity of reaction to LSD 25 during 6 hr of immersion and subsequent recovery up to 53 hr. All of the 16 fish treated recovered completely from the effects of the drug within 150 hr; x's indicate a rough estimate of the intensity of response. With exposure in water containing LSD 25 for several hr, 0.1 μg/ml may be determined by this technique. This is not illustrated in the table.

Immersion	1	2	3	4	5	6	7	8	9
Untreated									
¼ hr								x*	
½ hr								x*	
¾ hr								x*	
6 hr	in spring water							x*	
21 hr								x*	
53 hr								x*	
1 μg/ml									
¼ hr					x	x		x	
½ hr	in LSD 25		x		x	x		x	x
¾ hr		x	x	x	x	x	x	x	x
6 hr		x	xx	xx	xx	xx	xx	xx	xxx
21 hr	in spring water	x	x	x	x	x	x	xxx*	
53 hr								xx*	
5 μg/ml									
¼ hr		x			x			x	x
½ hr	in LSD 25	x	x		x	x	x	xx	xx
¾ hr		x	x	x	xx	xx	x	xx	xx
6 hr		xx	xxx	xx	xx	xx	xx	xx	xxx
21 hr	in spring water	x	x	x	x			xx*	xx
53 hr			x					xxx*	
25 μg/ml									
¼ hr		x	x					x	xx
½ hr	in LSD 25	xx	xx	x	x	x	x	xx	xxx
¾ hr		xxx	xxx	xx	xx	xx	xxx	xx	xxx
6 hr		xxx	xxx	xxx	xxx	xxx	xxxx	xxx	xxxx
21 hr	in spring water	xxx	xx	xx	xxx	xx	xx	x	xxxx*	xx
53 hr		x	x	x	x	x	x	x	xxxx*	x
50 μg/ml									
¼ hr		x	xx			x	x'	xx	x	xx
½ hr	in LSD 25	xx	xx	xx	x	xx	xx	xx	xx	xxx
¾ hr		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xx	xxx
6 hr		xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxx	xxxx
21 hr	in spring water	xxx	xx	xxx	xxx	xxx	xxx	xx	xxx*	xx
53 hr		x	xx	x	x	xx	xx	x	xxxx*	x

* Display toward a rival with aspects of fighting.

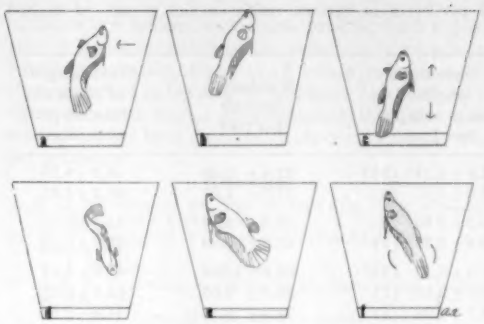

Fig. 1. The six diagrams illustrate the nine criterions or effects of LSD 25 upon the fighting fish, *Betta splendens*. Such effects are essentially exaggerated postures or caricatures of the normal fish.

1) Backward movements; accomplished almost entirely by pectoral fin movements (Fig. 1*a*).

2) Head up, body usually suspended in the vertical plane or some angle from the vertical. In maximum stage of narcosis the snout is kept at the surface. As effects begin to wear off, the fish sinks slowly below the surface until after 6 hr it might take a position 2 in. below the surface (Fig. 1*b*).

3) "Cartesian diver" effect. Treated fish sinks or rises very slowly in near-vertical plane without visible body movement except by means of pectoral fins (Fig. 1*e*).

4) "Barrel-roll" effect, change of position or location is by a peculiar rolling of the fish upon its long axis in the vertical plane (Fig. 1*a*, *f*).

5) "Trancelike" effect, motionless position maintained for minutes at a time at the peak of the narcosis. The "trance" is broken by a very brief change of position by means of a very slight stimulus. Succeeding "trances" become gradually shorter after cessation of treatment (Fig. 1*e*).

6) All movements of treated fish are slow and deliberate as compared with the typical swift and sudden movements of normal fish (Fig. 1*a*, *c*, *d*, *f*).

7) Treated fish exhibits a typical "kinking" in its body conformation, easily observed from above (Fig. 1*d*).

8) Lateral display, most commonly involving the ventral and dorsal fins, less usually the tail as well. This posture persists while fish is in trancelike state (Fig. 1*e*).

9) Pigmentation effects, best exhibited in juveniles. Immediate effect is darkening of basic body color. This fades slowly as recovery occurs (Fig. 1*f*).

Table 1 shows the manner in which the foregoing criterions may be used to follow the reactions of the fish to the drug. Note in the table a reaction of recovery that we have consistently observed. This reaction is a slow return to normal from the stuporlike state induced by the drug with coemplete recovery in the low dose range within a day and with the high dose range within a week. Although recovery usually occurs within a week, exposure to the drug has, in many cases, actually altered the social behavior. This will be described in a future paper. However, we should call attention to some of these aspects of behavior. For example, the lysergized fish can be aroused from a stupor by an attacking male and even counterattack. But after a brief battle, there is an immediate relapse into the stuporous state, showing many of the afore-mentioned nine criterions. Lysergized fish will respond rheotropically but not as effectively as untreated fish. All the effects have been observed in both sexes and in unsexed juveniles. Quantitative data are not yet available on the way weight, age, and dosage are related. The qualitative data hold for the species ranging in body length from 1 in. to full adult size, as studied at Cold Spring Harbor in the summer of 1954. Fish were obtained from various dealers and, consequently, were of heterogeneous genetic make-up.

In conclusion, we would like to point out that our technique provides a new bioassay method for LSD 25 and possibly other ergot drugs. For example, LSD 25 in urine and other body fluids is difficult to determine by chemical means. Preliminary experiments on urine show that *Betta* has essentially normal activity in spring water containing as much as 25 percent of urine for at least as long as 44 hr. This opens up the possibility not only of detecting LSD 25 in urine, but also of studying the urines of clinically schizophrenic patients for chemical agents occurring naturally, which might be the cause of clinical schizophrenia in man. It should be emphasized that not a single fish has been lost owing to the action of the drug, regardless of dosage used, even after the injection of 50 μg in the caudal musculature.

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3. This investigation was supported by a grant from the Geschickter Fund for Medical Research, Inc. We are indebted to Sandoz Chemical Works, Inc., for supplies of the lysergic acid diethylamide and its derivatives.

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Inhibition of Growth of Excised Tomato Roots by Desoxypyridoxin and Its Reversal by Pyridoxin

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Using microorganisms or animals as test material (*1*, *2*) a number of analogs of pyridoxin have been found to act as antimetabolites. Similar results using test material from higher plants are scanty. Robbins (*3*) studied the specificity of pyridoxin in the nutrition of excised tomato roots and found that it could be replaced by either one of two acetoxy analogs. Two other analogs inhibited growth, but it was not shown that pyridoxin could prevent the inhibition. It has, however, been shown (*4*) that 4-desoxypyridoxin (DOP) inhibited the increase in nicotinic acid and ascorbic acid found in certain germinating pulse seeds

Table 1. The effect of supplying desoxypyridoxin and pyridoxin in various ratios on the growth of excised tomato roots.

Level of desoxypyridoxin	Level of pyridoxin	Ratio of analog to metabolite	Increase in length of main axis per root (mm)	Number of laterals per root	Total length of 10 basal laterals per root (mm)
30	10.0	3:1	91.6 ± 4.14* (9)†	32.3 ± 2.08	66.3 ± 4.96
300	100.0		102.2 ± 2.55 (6)	37.7 ± 2.51	40.2 ± 4.83
10	3.0	10:3	109.3 ± 2.86 (8)	39.6 ± 1.94	41.4 ± 4.15
100	30.0		109.4 ± 5.53 (7)	43.6 ± 2.89	52.0 ± 5.29
5	0.5	10:1	87.0 ± 5.15 (7)	26.9 ± 10.96	37.8 ± 3.24
10	1.0		100.7 ± 3.19 (7)	36.6 ± 3.05	44.1 ± 6.07
30	3.0		95.3 ± 2.98 (8)	34.6 ± 2.15	44.6 ± 2.96
100	10.0		85.7 ± 3.56 (7)	26.9 ± 1.50	51.7 ± 2.09
300	30.0		72.3 ± 3.53 (7)	23.6 ± 1.65	48.6 ± 4.05
30	1.0	30:1	35.1 ± 4.29 (7)	15.6 ± 1.73	60.9 ± 7.58
300	10.0		9.5 ± 0.53 (8)	7.3 ± 0.49	
30	0.5	60:1	10.8 ± 1.37 (8)	9.5 ± 0.78	
100	3.0	100:3	27.0 ± 4.42 (8)	14.0 ± 1.92	
1000	30.0		5.3 ± 0.89 (7)	5.9 ± 0.41	
100	1.0	100:1	4.7 ± 0.84 (6)	5.8 ± 0.16	
300	3.0		4.2 ± 1.08 (6)	5.5 ± 0.25	
	0.5		95.7 ± 4.99 (6)	32.8 ± 2.51	47.5 ± 8.17
	1.0		92.0 ± 3.68 (8)	31.1 ± 2.59	58.3 ± 6.16
	3.0		81.9 ± 6.96 (7)	31.0 ± 2.96	57.6 ± 9.06
	10.0		93.3 ± 4.99 (7)	33.9 ± 4.71	61.9 ± 7.15

* Standard error.
† Number of replicates.

and that the inhibition was reversed by pyridoxin. The type of antagonism between pyridoxin and DOP was not established.

The evidence in the literature (*1, 2*) shows that analogs of pyridoxin are not competitively antagonistic toward pyridoxin in animals or in microorganisms that do not require vitamin B_6 for growth. The experiment reported here was designed to determine whether this was the case using DOP with the higher plant material represented by cultures of excised tomato roots. The general techniques used are described elsewhere (*5*). The clone of excised roots used as source of inocula requires pyridoxin, pyridoxal, or pyridoxamine for growth. It is designated R5 (*6*). The inhibition of growth on addition of various levels of DOP to the basal medium plus thiamine and its reversal by pyridoxin are shown in Table 1. The standard concentration (1.0) of either pyridoxin or DOP was equivalent to $4.9 \times 10^{-7} M$ of the free base.

Inhibition by concentrations of DOP of 10, 30, 100, and 300 times the standard concentration was completely reversed by increasing the concentration of pyridoxin. Therefore, within the limits of the method, the antagonism can be considered competitive. However, when concentration of DOP was increased and ratio of analog to metabolite remained constant (10:1 or 30:1) the growth of main axis decreased. In accordance with the principles involved in inhibition analysis (*1*), such an effect on a competitive inhibition could be obtained if the competition occurred between products of the analog and metabolites as supplied in the medium.

The exact mechanism whereby analogs of pyridoxin inhibit growth and enter into competition with vitamin B_6 is not clearly understood. The subject is reviewed elsewhere (*7*), and some additional evidence from enzyme studies *in vitro* has been presented (*8*). The mechanism probably varies with the analog and with the organism. In some instances it may involve the conversion of DOP to DOP-phosphate, which then competes with pyridoxal phosphate or pyridoxamine phosphate. It has been shown (*5*) that excised roots of the clone used here utilize pyridoxal or pyridoxamine in place of pyridoxin. The results obtained here, therefore, are in agreement with the view that the antagonism between pyridoxin and DOP involves prior conversion to the phosphate.

The data for growth of laterals are not completely in agreement with those for main axis. Thus, at the five levels of DOP at which the ratio of analog to metabolite was 10:1, growth of laterals did not decrease with increase in concentration. An explanation of this discrepancy is hard to find but may involve the mechanism of the correlative influence of the main apex upon growth of laterals (*9*).

A final point of interest is the fact that growth of the main axis was significantly greater in the presence of DOP and pyridoxin in the ratio 10:3 than with any concentration of pyridoxin alone. This indicates a function of pyridoxin in some mechanism (or mecha-

nisms) which inhibits or restricts growth. Such a possibility is also indicated by the reduction in growth in length of the main axis obtained with pyridoxin at 3.0 times standard in the control mediums. This inhibitory effect of pyridoxin, at approximately this same concentration, has been observed in other experiments not yet published.

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Effect of Linear Energy Transfer on Radiation-Induced Chromosome Aberrations in *Tradescantia* Microspores[1]

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Comparative studies in which various types of ionizing radiations were utilized have provided evidence for a marked effect of ionization distribution (specific ionization) on the production of chromosome aberrations in *Tradescantia* microscopes. These studies have involved the use of different radiations—for example, x-rays and fast neutrons (*1*) and alpha particles (*2*)—to provide different patterns of ionization distribution. The recent availability of more powerful particle accelerators and improved exposure techniques have now made possible direct comparisons of the effect of linear energy transfer (rate of energy loss) utilizing single particle beams (*3*).

This paper presents the results of some experiments (*4*) carried out in the summer of 1948 with the 184-in. Berkeley cyclotron. The experiments must be considered to some extent preliminary, since in certain instances, especially with alpha-particle exposures, the quantitative data are not as extensive as is ordinarily desirable. Since it has not yet proved feasible to expand these observations, as was originally contemplated, it seems desirable to record the data and conclusions obtained to date.

Deflected beams of 190-Mev deuterons and of 380-Mev alpha particles were used. The particles had nearly parallel trajectories, and the radiation field covered an area of about 1 in. in diameter. By placing absorbers in front of the plant, the beam energy could be lowered. Data are reported here for high-energy deuterons having linear energy transfer (LET) of 0.73 kev/μ tissue (position I); deuterons, slowed by 1842 mg/cm^2 of aluminum, having a LET between 5 and 30 kev/μ at the neighborhood of the Bragg ionization peak (position III); high-energy alpha particles with LET of 2.9 kev/μ. Buds from fresh inflorescences were immersed in water and exposed near the center of the radiation field, with the axis of the buds parallel to the beam. Because of the variations of the size of buds and position of the pollen grains within, both the dose and LET of the low-energy deuterons may be in considerable error. Exposure normally took less than 1 min, and dosimetry was done by means of parallel plate ionization chambers (*3*).

Following irradiation, inflorescences were placed in containers of water and maintained at room temperature. Slides were prepared by the acetocarmine smear technique at 24 hr following radiation exposures for an analysis of chromatid aberration frequencies.

The results reported here are confined to isochromatid and chromatid aberration types. The first comparison was obtained in exposures of inflorescences to deuterons of two different energies. The results are given for isochromatid aberrations in Table 1 and Fig. 1 and for chromatid aberrations in Table 1. Standard errors have been calculated as described by

Table 1. Frequencies of isochromatid and chromatid aberrations induced by deuterons in *Tradescantia* microspore chromosomes. Slides made 24 hr after irradiation. (Position I, low LET; position III, high LET. See text.)

Expt.	Dose (rep)	Position	No. of cells	Isochromatid aberration	Isochromatids per cell	Chromatid aberration	Chromatids per cell
1	36	I	675	52	0.08 ± 0.01	34	0.05 ± 0.01
1	70.7	I	558	68	.12 ± .01	29	.05 ± .01
2	24.2	I	600	25	.04 ± .008	15	.025 ± .006
2	46.7	I	300	18	.06 ± .01	12	.04 ± .01
2	97	I	250	56	.22 ± .03	24	.10 ± .02
2	187	I	50	22	.44 ± .09	14	.28 ± .07
1	48.2	III	152	76	.50 ± .06	34	.22 ± .04
2	11.0	III	250	33	.13 ± .02	8	.03 ± .01
2	22.4	III	350	57	.16 ± .02	24	.07 ± .014
2	44.5	III	300	100	.33 ± .03	27	.09 ± .02
2	65.7	III	210	131	.62 ± .05	48	.23 ± .03

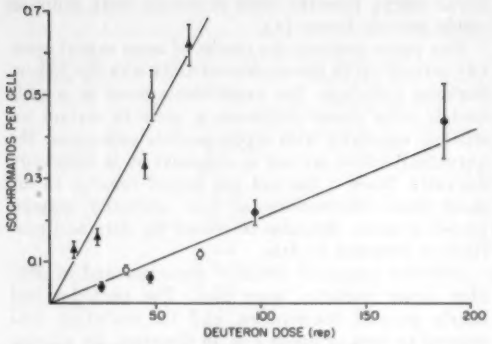

Fig. 1. Relationship between deuteron dose and isochromatid aberrations per cell. Position I, low LET: ○, expt. 1; ●, expt. 2. Position III, high LET: △, expt. 1; ▲, expt. 2.

Table 2. Frequencies of isochromatid aberrations induced by alpha particles in *Tradescantia* microspore chromosomes. All exposures at position I (low LET). Slides made 24 hr after irradiation.

	Dose (rep)	No. of cells	Isochromatid aberrations	Isochromatids per cell
Expt. 3	3.1	50	0	0.0
	6.0	100	2	.02 ± 0.014
	23.1	100	3	.03 ± .017
	46.5	100	10	.10 ± .03
	93	50	12	.24 ± .07
Expt. 4	25	107	6	.056 ± .02
	54	100	15	.15 ± .04
	107	40	18	.37 ± .10

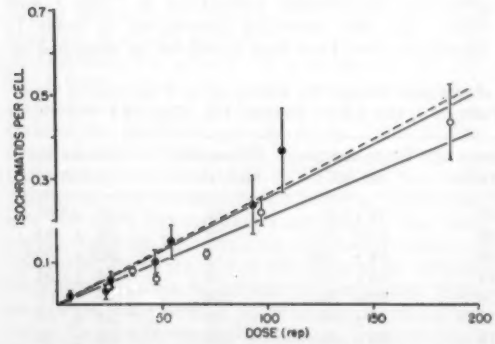

Fig. 2. Relationship between isochromatid aberrations per cell and radiation dose with three different radiations in exposures giving approximately equal linear energy transfer (LET): ○, 190-Mev deuterons; ●, 380-Mev alpha particles; - - -, about 100-kv x-rays.

Catcheside, I. ·, and Thoday (*5*). Although in both instances the relationship between radiation dose and aberration yield has been plotted as linear, the possibility that the exponent in the dose-effect relationship may be somewhat greater than 1 is not excluded. It is clear that for both kinds of aberrations, there is a marked increase in yield with an increased rate of energy loss. The relative biological effectiveness for chromatid aberrations is approximately 2.7 and that for isochromatids, 4.5. Thus these observations agree with previous ones (*1*) in indicating a greater efficiency in chromosome aberration production by radiations having high specific ionization.

A further comparison was made of aberration production with 380-Mev alpha particles, exposures being made in the region of low rate of energy loss. These data are presented in Table 2 and are plotted in Fig. 2. Comparative data have also been included in Fig. 2 for two other radiations involving exposures at comparable rates of energy loss. The data for deuterons are those obtained in this study; those for x-rays are taken from the combined observations of several investigators, as reported by Lea (*6*, Fig. 34). It is clear that, within the limits of error, there is no difference in the effects of these three radiations when comparisons are made under comparable conditions of linear energy transfer. These results thus indicate in a striking manner that the important factor in determining radiobiological effectiveness is not the type of ionizing particle but rather the rate at which energy is dissipated along the particle path.

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Enzyme Concentrations in the Brain and Adjustive Behavior-Patterns

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This is a preliminary report of a close relationship between concentrations of an enzyme in the cerebral cortex of the rat and its adjustive behavior-patterns.

For our behavior test we used a standardized insoluble maze (*1*). The rat cannot learn the maze, since after each run the pattern of illumination cues and of

Table 1. Hypothesis-preference scores and cortical cholinesterase activity in 10 spatial-preference rats and 10 visual-preference rats, with *t*-tests for differences between groups.

Group I, spatial						Group II, visual					
Rat	Pref. scores*	Cholinesterase activity in different cortical areas†				Rat	Pref. scores	Cholinesterase activity in different cortical areas			
		V	S	M	(V+S)/2			V	S	M	(V+S)/2
B-1	+185	56	69	62	62	D-44	−250	41	66	76	54
B-7	+150	52	72	64	62	D-12	−173	47	57	64	52
C-1	+142	56	61	58	58	X-52	−165	40	46	49	43
C-17	+136	51	71	70	61	D-46	−162	52	78	80	65
(B-3)	(+121)	(27)	(47)	(46)	(37)	D-18	− 92	41	54	66	48
Y-74	+103	79	55	69	67	C-3	− 74	46	52	54	49
C-28	+ 69	55	64	65	60	C-10	− 58	48	53	59	50
B-9	+ 42	56	69	82	62	X-55	− 51	52	54	63	53
C-26	+ 36	56	68	73	62	X-51	− 49	45	54	61	50
C-9	+ 35	59	70	74	64	X-53	− 24	63	63	70	63
Means N = 9	+ 99.8	57.8	66.6	68.6	62.0	Means N = 10	−109.8	47.5	57.7	64.2	52.7
Over-all means (n = 19)								52.4	61.9	66.3	57.1
t for differences between groups								2.96	2.54	1.12	3.92
p								.01	.02	.3	.001

* Plus values indicate spatial, minus values, visual preferences.
† Expressed as moles ACh × 10^{10} hydrolized per minute, per milligram of tissue.

correct alleys is changed. In its attempts to reach the food box the rat displays "hypotheses." Thus, for example, an animal may systematically choose the lighted alleys (a "visual hypothesis") or it may consistently choose the left alleys (a "spatial hypothesis"). This hypothesis behavior test has these advantages:

1) In 5 days of testing the rat makes 240 choices, and the strength of its hypotheses can be reliably quantified.

2) The rats show either visual or spatial hypothesis-preferences and large individual differences in the strengths of these preferences (*1*).

3) These preferences are stable over time (*2*) and are genetically determined (*3*).

4) This test requires a minimum of physiological intervention by the experimenter.

5) The behavior is significant in the organism's normal adjustments—it reflects a perceptual selectivity that must occur if the animal is to organize the welter of stimuli impinging upon it.

6) Finally, hypothesis-preference can be altered predictably by ablations in the visual and somesthetic areas of the cortex (*2*), thus suggesting the most profitable loci for chemical analysis.

Our chemical test measured the concentration of cholinesterase (ChE) in six areas of the cortex. In each hemisphere 10 to 20 mg of tissue was taken from the visual, somesthetic, and motor areas (the latter area for control purposes). It should be emphasized that the chemical tests were made in complete ignorance of the behavioral results; strictly comparable amounts of tissue were taken from animals of both groups. The samples of tissue were weighed and homogenized in cold 0.9-percent saline and diluted to 10 ml. In each determination 8 to 12 mg of tissue was used. The difference in tissue weight was not associated consistently with different areas. The rate of hydrolysis of acetylcholine perchlorate (ACh) at *p*H 7.95 and 37°C was determined anaerobically with a *p*H meter equipped to maintain constant *p*H through an automatic-recording syringe buret (*4*). Corrections were made for the "blank" hydrolysis of ACh (*5*).

Sixty male animals (between 80 and 90 days of age) were tested behaviorally. ChE analyses were made of the brains of 10 rats with strong spatial preferences (group I) and of 10 rats with strong visual preferences (group II). After behavioral testing, the animals were decapitated, and the samples of tissue were removed by gross dissection. The brains were preserved for exact determination of the sites of ablations.

The data are presented in Table 1. (The values for animal B-3, the first of our experimental animals to be tested chemically, deviate so widely—approximately *four* standard deviations—from the means of the rest of its group, that we have not used its data in the computations that follow.) The most general result is that the ChE activity of the rat's visual cortex is approximately 20 percent lower than that of either the somesthetic or the motor area. The respective *t* values are 3.83 and 5.92; thus, the probability of obtaining such differences by chance is approximately 1 in 1000. Tower and Elliott (*6*) reported no significant differences among cortical areas in the rat; however, they did not use areas defined functionally and cytoarchitectonically, and their observations were too few to permit tests of significance.

Perhaps even more interesting are the enzymatic differences observed when the animals are separated into two groups by the behavioral test. In the first place, the visual-hypothesis rats show a progressive

and statistically significant increase in ChE activity from the visual, through the somesthetic, to the motor area. The spatial animals do not show this consistent pattering. Even more striking are the differences in *level* of ChE activity. Group I shows significantly higher ChE activity than group II in both sensory areas but not in the control motor area. The greatest difference is found when the ChE activities in the two sensory areas are averaged, $(V+S)/2$. All 9 of the spatial animals score *above* 57.1 (the mean for all 19 animals) and 8 of the 10 visual animals score *below* 57.1.

At present we would entertain two kinds of theoretical explanations to account for our data. The first would relate hypothesis-preference to ChE dominance of one of the sensory areas. The second theory would posit a general "power" factor—high ChE activity in the sensory ("cognitive"?) areas makes for a more generally adaptive animal (more "intelligent"?). We have begun research to test both the sensory-area dominance theory and the general "power" theory.

Most of the animals were drawn from Tryon's (*6*) three strains—maze-bright animals, maze-dull animals, and a cross between the two (labeled "B," "D," and "C," respectively in Table 1). Behaviorally, the B's are spatial, the D's visual, and the C's are found in both groups. Chemically, the B's tend to be high on the $(V+S)/2$ measure, the D's low, and the C's show a range that overlaps those of the other two strains. We have initiated a selective breeding experiment to test the suggestion that ACh metabolism in the cortex may be genetically determined and that this, in turn, determines hypothesis-preference (*8*).

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11 August 1954.

Preliminary Studies of the Intensity of Light Scattered by Water Fogs and Ice Fogs

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This study (*1*) was initiated to investigate photometrically the angular variation of the intensity of light scattered by artificially produced water and ice aerosols and to evaluate the usefulness of photometric techniques for the study of Alaskan ice fogs (*2*) and supercooled water fogs.

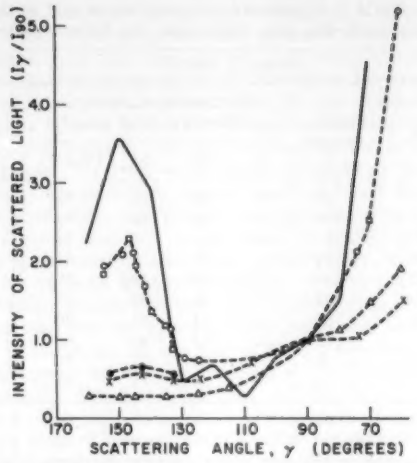

Fig. 1. Angular variation of intensity of light scattered in a horizontal plane by water fogs and ice aerosols. Interpretation of symbols: ○ water fog, −17°C; □ water fog, −12°C; ● ice aerosol, −16°C, Dry-Ice seeded; × ice aerosol, −10°C, AgI seeded; △ ice aerosol, −12°C, AgI seeded; —— theoretical curve for droplets of 3.5-μ radius (Gumprecht *et al.*).

Atmospheric optical phenomena caused by the scattering of light by water or ice particles (*3*) suggest that characteristic curves for the angular variation of scattered light would be different for ice and water fogs when observed photometrically. The fogbow seen on a sheet of water droplets at an angle between 140 and 143 deg to the incident rays of the sun and halos seen at an angular radius of 22 or 46 deg around the light source when looking through a suspension of ice crystals in the atmosphere are examples of these phenomena. Rainbows and halos are treated theoretically by Bucerius (*4*) and Ramachandran (*5*), respectively. Sinclair (*6*) has summarized investigations of the scattering of light by aerosols consisting of particles with a radius of 1.0 μ or less. In contrast, ice fog particles are most frequently 5 to 10 μ in radius (*2*), and water fog droplets have an average radius of about 20 μ and a minimum radius of about 2 μ (*7*).

The experiments reported here were carried out in a home freezer. Fogs were generated continuously by controlled heating of a beaker of water and were converted to ice form by seeding with either Dry Ice or silver iodide. The freezer contained a microphotometer (*8*) adapted to record the ratio of the intensity of scattered light to the intensity of the incident beam in a horizontal plane. The beam had a wavelength of 5460 A. Angles observed were from 0 to 160 deg. A second detector monitored the light scattered vertically at 90 deg to the incident beam to provide a continuous check on 90-deg scattering and on the symmetry of the scattering in the vertical and horizontal planes. Cor-

responding readings of the horizontal and vertical detectors were obtained on recorders with matched chart speeds.

Readings of the horizontal detector were corrected to represent scattering intensity for the volume of the beam seen at 90 deg. To simplify comparisons between fogs of different or varying density, the intensity of scattered light was recorded as the ratio of the readings at each angle to a horizontal reading obtained at 90 deg after each angular setting. In the notation used, direct transmission is 0-deg scattering, whereas light scattered directly back toward the source would be 180-deg scattering.

Characteristic curves obtained for the angular variation of the intensity of light scattered in a horizontal plane by the water and ice aerosols and a theoretical curve for monodisperse water droplets are shown in Fig. 1.

All tests of unseeded water fogs showed high scattering intensities at low scattering angles, decreasing scattering to about 125 deg, and a maximum in high-angle scattering in the region of 147 deg. Unseeded fogs did not scintillate.

The theoretical curve was obtained from computed values published by Gumprecht and others (*9*) for the angular distribution of light at 5460 A scattered by water droplets 3.5μ in radius. At 150 deg, it shows a maximum scattering of 3.6 times the 90-deg values. In experimental water fogs, the maximum occurred at 147 deg and was consistently greater than twice the 90-deg value. The occurrence of maximum scattering at an angle intermediate between that shown in the theoretical curve and that found for the fogbow (140 to 143 deg) suggests a particle radius intermediate between 3.5 and 30 μ for the fogs used in these studies and indicates the possibility that the position of maximum scattering might be used as a measure of average particle size in atmospheric fogs.

All tests of seeded fogs showed high scattering intensities at low angles, decreasing to very low intensities at angles greater than 125 deg. Scintillations were observed a few seconds after seeding. In the region of 147 deg, the scattering of an ice aerosol was one-fifth or less than that of a water aerosol having the same scattering at 90 deg. A slight inflection in some ice aerosol curves in the region of 147 deg probably indicates the presence of some water droplets or ice spheres. The ratio of the scattering intensity in the horizontal plane at the maximum in the region of 147 deg to the scattering intensity at 90 deg appears to provide a measure of the relative proportion of spherical water or ice particles to crystalline ice particles in an aerosol.

Conversion of a water aerosol into ice form led to an increase of the 90-deg horizontal scattering at the expense of the 90-deg vertical scattering by as much as 40 percent. It is suggested that this effect is caused by, and provides a measure of, the orientation of the ice crystals in an ice aerosol.

Further studies of the photometry of ice and water aerosols are being evaluated and will be reported later.

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1. This research was sponsored by the Geophysics Research Directorate of the Air Force Cambridge Research Center, Air Research and Development Command, under contract No. AF19(122)-634. We wish to acknowledge helpful discussions with A. P. Brady and Ilia G. Poppoff of these laboratories.
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11 August 1954.

Identity of Sweat Glands Stimulated by Heat, Epinephrine, and Acetylcholine

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It has been clearly demonstrated that both epinephrine and acetylcholine activate sweat glands (*1*, *2*). This study (*3*) was undertaken to determine whether acetylcholine and epinephrine stimulate the same sweat glands, or separate groups of glands, and to correlate the response to these stimuli with that evoked reflexly by heat.

On the forearm of each of two subjects an area of skin approximately 0.5 cm in diameter was identified by two small moles. At weekly intervals, after the hairs were clipped short, the test areas were painted with tincture of iodine and then coated with a 50-percent emulsion of starch in castor oil, as described by Wada (*2*). When spontaneous sweating occurred at room temperature, the subject's back was heated with an infrared lamp until he felt a generalized diaphoresis. When on the cool days no spontaneous sweating occurred, the starch emulsion was gently removed with cold water, iodine was reapplied, 0.05 ml of either acetylcholine chloride (1:10,000) or epinephrine hydrochloride (1:10,000), each in 0.9-percent NaCl, was injected into the test area intradermally, and the starch emulsion was reapplied. Before application of the starch in each case the moles were marked with a fine spot of India ink.

When the sweating response was clearly represented by isolated black spots a photograph of the test area was taken at a uniform magnification, using an instantaneous flash of light to avoid heating the arm. In each case after the drug injections, the complete absence of spontaneous sweating was verified by inspection of areas of skin similarly prepared but at a short distance from the injection site.

From the original negatives, transparent positives

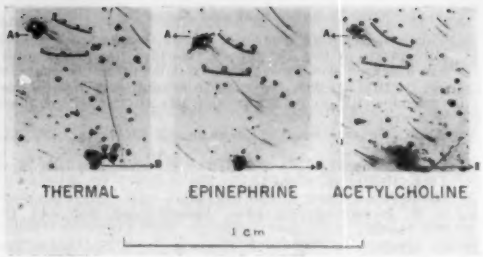

Fig. 1. Sweat responses to the three stimuli in one subject. *A* and *B* are the reference spots (moles), marked with India ink before photographing. The added lines are beneath two groups of sweat spots that appear in all three instances. Other coinciding spots may be seen.

were made so that the spots of sweat appeared black upon a pale transparent background. It was thus possible to attempt superimposition of the photographs in front of a bright light, using the two moles and the clipped hairs as reference points. This simple technique revealed the following: (i) Some of the individual sweat glands were stimulated on one occasion and not on another, despite the reapplication of the same stimulus and the reappearance of an approximately equal number of black spots in the same area. This "responsiveness" of the glands appeared to be capricious. (ii) It was nevertheless clear that, despite this individual variation, a very similar pattern of sweat glands was produced in each case by heat, epinephrine, and acetylcholine (Fig. 1) The similarity in pattern was so obvious that prints from any two stimuli could be superimposed in such a way that a large percentage of the spots coincided.

This visual impression was tested statistically as follows: Some of the positive transparencies were placed in a photographic enlarger, and the shadows were projected upon white paper at a standard distance and over a standard area. The black spots from a given print were then traced in a given color, and upon the same area of paper the spots of another print were traced in another color. Spots touching each other were considered coincident. In this manner the coincidence of spots derived from each subject was tabulated for the following combinations: (i) thermal patterns, (ii) epinephrine patterns, (iii) acetylcholine patterns, (iv) thermal and epinephrine, (v) thermal and acetylcholine, (vi) epinephrine and acetylcholine, (vii) a print produced by any of the three stimuli and the same print turned 180°, and (viii) a print produced by any of the three stimuli and a print produced by another stimulus rotated 180°. Random coincidence of spots would be directly proportional to the product of the number of spots in any two prints if all the spots were of equal size. Since both the differences in size of the spots and the average size of spots were negligible, as compared with the total area, for each pair of prints plotted a value ("J") was computed, representing the ratio of the number of coincident spots to the product of the total number of spots in each print that fell within the tabulated area. The average J-value for one stimulus with another at 180° and one print with another at 180°, or the two combined, was about 0.0027, whereas all other J-values were in the neighborhood of 4 times as great, about 0.01 or more.

No significant difference occurred between average J for the prints compared with themselves at 180° of rotation and average J for different prints so compared ($p > 0.2$). This suggests a random distribution of the sweat glands, and hence all prints compared at 180° were pooled to determine J for chance coincidence. There was no significant difference between J for the prints produced by identical stimuli and J for prints produced by different stimuli ($p > 0.5$). The difference, however, between J for the prints superimposed properly and J for the prints superimposed at 180° was highly significant ($p < 0.001$). In other words, coincidence among sweat patterns evoked by *different* stimuli was as good as that produced by the *same* stimulus on different occasions. The extent of this coincidence was far greater than that demonstrated to occur at random.

This degree of similarity among the patterns evoked by the three different stimuli would not be found if each stimulus involved a different set of sweat glands. The findings are consistent with the view that the same individual sweat glands are stimulated by epinephrine and acetylcholine, at the concentrations used, and reflexly by heat. This demonstration does not imply a dual innervation of the sweat glands.

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3. Supported by a Lilly Research grant. We wish to thank Donald Jenden for valuable advice and Frank Wilbar and Carmelita Salazar for technical assistance.

23 August 1954.

Resistance of *M. tuberculosis* to the PAS Salt of INH

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Preliminary tests have shown that the p-aminosalicylate (PAS) salt of isonicotinylhydrazine (INH) (*1*) is unexpectedly highly active in *in vitro* tests against *M. tuberculosis* (H 37 Rv). This tuberculostatic effect was confirmed in therapeutic tests carried out on the guinea pig. Further *in vitro* tests on the activity of the PAS salt of INH (*2*) against *M. tuberculosis* (H 37 Rv) (*3*) and certain resistant strains are herewith reported.

In our *in vitro* experiments (serial dilution tests in

liquid Dubos-culture medium, each tube containing 5 ml and an inoculation with 1 drop of a 10-day culture of H 37 Rv-Dubos-Tween culture) the PAS salt of INH shows a tuberculostatic effect which seems often to exceed that of physical mixtures of PAS and INH. Whether this difference is statistically significant is still not clear (*4*).

On the basis of these experiments it appeared that it would be of interest to determine the tuberculostatic effect of the PAS salt of INH on resistant strains in routine testing. The primary cultures were inoculated into liquid Dubos-Tween culture medium. When growth had proceeded sufficiently, the culture was standardized to a predetermined degree of turbidity and then inoculated into liquid Dubos culture medium containing various concentrations of the tuberculostatics to be tested. These last-mentioned Dubos cultures contained no Tween and thus differed from the primary cultures. In this manner unreliable results owing to the addition of Tween are avoided (*5, 6*). This method simplifies the reading of results, since the bacilli show a flaky type of growth under these conditions.

The experiments with 7 of the 32 strains tested are summarized in Table 1. The results obtained during these resistance tests are unexpected in that bacilli resistant to both PAS and INH are sensitive to the PAS salt of INH.

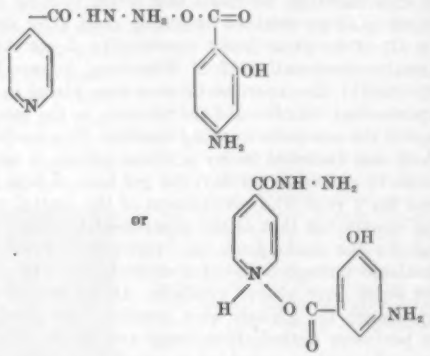
Table 1. Resistance determinations.

Strain:		0.1	1.0	5.0	10	50	100	Control
		Drug concentration (μg/ml)						
147/54	SM	+++	++	++	–	–	–	+++
	PAS	+++	+++	+++	++	(+)	–	
	INH	+++	–	–	–	–	–	
	Salt	++	–	–	–	–	–	
790/54	SM	+++	–	–	–	–	–	+++
	PAS	+++	+++	+++	+++	+++	++	
	INH	++	–	–	–	–	–	
	Salt	+++	–	–	–	–	–	
2725/53	SM	–	–	–	–	–	–	+++
	PAS	+++	–	–	–	–	–	
	INH	+++	+++	++	++	+	–	
	Salt	+++	++	+	–	–	–	
3071/53	SM	–	–	–	–	–	–	+++
	PAS	+++	(+)	–	–	–	–	
	INH	+++	+++	+++	+++	++	+	
	Salt	+++	(+)	–	–	–	–	
2757/53	SM	(+)	–	–	–	–	–	+++
	PAS	+++	+++	+++	++	++	++	
	INH	+++	+++	++	+	–	–	
	Salt	+++	++	+	–	–	–	
3102/53	SM	–	–	–	–	–	–	+++
	PAS	+++	+++	+++	+++	+++	++	
	INH	+++	+++	+++	++	++	+	
	Salt	+++	+++	++	–	–	–	
2802/53	SM	++	–	–	–	–	–	+++
	PAS	+++	+++	+++	++	+++	++	
	INH	+++	+++	+++	+++	+++	+	
	Salt	+++	+++	++	–	–	–	

Identification of symbols: +++, ++, +, various degrees of growth; (+), doubtful growth; –, no growth; SM, Streptomycin; Salt, PAS salt of INH.

Resistance tests have shown that the PAS salt of INH possesses a superior tuberculostatic effect even where strains resistant to both PAS and INH are concerned. The effect is scarcely to be explained on the basis of the small amount of PAS present in the salt (*7*). It seems more probable that the PAS salt of INH possesses in itself a tuberculostatic effect of its own.

The PAS salt of INH behaves in many respects as a new chemical compound. Being a salt, it may, of course be split into its components in the same way as other organic salts. Its structure may be represented as



It may be crystallized from aqueous ethanol or methanol as fine, yellow needles and shows the following elementary analysis in percentages: found, C = 53.81, H = 4.95, N = 19.54; calculated for $C_{13}H_{14}N_4O_4$, C = 53.79, H = 4.86, N = 19.30. It melts between 140° and 142°C with decomposition and is soluble to the extent of 1 to 2 percent in water.

That the PAS salt in INH possesses its own specific tuberculostatic properties is borne out by the clinical results obtained by Hueck (*8*) and Krug (*9*), using this substance. Patients who did not respond to INH, PAS, or streptomycin therapy responded to treatment with the PAS salt of INH.

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16 August 1954.

Communications

Incidence of Lung Tumors in Albino Mice Exposed to Smoke of Cigarette Paper

We have attempted to investigate experimentally the major ingredients of the cigarette as possible carcinogenic agents of lung tumors. The smoke of the cigarette paper has been studied, and the results are reported in this article.

In this experiment, 74 young, sexually mature A/Jax mice were used; 38 of these served as experimental and 36 as control animals. The sexes were approximately equal in both groups. A standard grade of cigarette paper was used for furnishing the smoke. By experimenting, we found that better burning conditions could be obtained by rolling sheet after sheet, 9 in all, of the paper into a cigarettelike object. After normal acclimatization [J. M. Essenberg, *Science* **116**, 561 (1952)], the experimental mice were placed in the experimental chamber and the controls, in the control cage of the automatic smoking machine. This machine, which was described in my previous article, is set to smoke 12 cigarettes per day, one per hour, 6 days per week for 1 year. The environment of the control mice was exactly like that of the experimental animals except for the smoke from the "cigarettes." Fresh air circulated through both cages continuously, and food and water were always available. At the end of the experiment, the animals were sacrificed and fixed by the perfusion method. Both lungs and the heart were removed together, embedded in paraffin, sectioned and mounted serially, and stained by the hematoxylin-eosin method.

There is a very slight preponderance of tumors in the experimental over the control mice, which is not significant by statistical analysis. There were eight carcinomas and five adenomas in the experimental, and five carcinomas and six adenomas in the control mice. Hyperplasia of the lung tissue was present in both groups. Also, pneumonia and lung congestion occurred about equally in both groups. Their weight curve and reproductive capacity differed in this experiment from those of previous studies. The mean weight of the two groups of animals remained practically the same; the difference was 0.75 g in favor of the controls. For the first time in our studies, three litters of young were produced by the experimental mice in the smoking chamber. The control mice produced freely.

The results of this experiment indicate that cigarette paper has little or no effect on the generation of lung tumors in albino mice.

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5 November 1954.

Financing of Medical Schools

I was much interested in the editorial in the issue of 20 August, page 5A. The financing of medical schools is a very complicated business, but I do not think that the answer is the method advocated in your editorial.

Although going in debt to obtain an education has been a success in thousands of cases, to make it a mass project would have an adverse psychological effect on the majority of students. It would be too much of a millstone around their necks; and the desire to get out from under the burden could well lead to undesirable practices in many cases. Many who could do valuable research work would have to secure any practice they could in order to get out of debt.

I am one who believes that the government should divert a small percentage of the money spent on European aid to help medical schools, even if the bigwigs in the A.M.A. do not agree with me. I have been a member of the A.M.A. for many years but am not a "yes man."

J. W. ROBINSON

2686 Locksley Place, Los Angeles 39, California

7 September 1954.

The writer is responsible for the note on "The financing of medical schools" that appeared on the editorial page of the 20 August issue. Contrary to J. W. Robinson's implication, I did not advocate (nor did I oppose) the solution proposed therein. I was merely presenting Brian Bird's views on the matter, without any attempt to assess their feasibility or desirability.

The problem of financing medical schools, more particularly private ones, is especially acute and of prime importance. It is therefore highly desirable that all possible solutions be examined with the greatest care. Bird's suggestion represents only one possible solution. Robinson has offered another, involving governmental aid. I cannot pretend to know whether either of these proposals is practicable or advisable. But I do believe that the proper solution of this serious problem can be accomplished only after all possible approaches have been considered.

WILLIAM L. STRAUS, JR.

Laboratory of Physical Anthropology, Johns Hopkins University Baltimore, Maryland

9 November 1954.

Kodak reports to laboratories on:

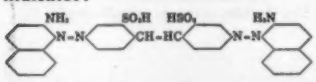
a disazostilbeneaminodisulfonate for precision titrimetry...telling your story without jump or jerk...a new material for the base of our business

Waterman's find

This is how come *4,4'-Bis(2-amino-1-naphthylazo)-2,2'-stilbenedisulfonic Acid Disodium Salt* became Eastman Organic Chemical No. 7000.

We had run across several papers by a chemist in the water supply department of a large city who was bothered by the shortcomings of a certain tool of his trade, namely the indicator methyl orange. This has a rather weak color change which occurs perceptibly only at pH 4.6 and is therefore no good for alkalinities below 150 ppm in acid-carbonate titration. In the interests of precision titrimetry, he had felt, it is better to have a pH indicator change from a light color to a dark color as an end-point is reached, instead of the other way around. In the disazostilbeneaminodisulfonates he found what he was looking for. A number of dyes of this series gave useful color responses in the broad pH range between 8 and 4. Among the several dyes investigated in this class was an obscure item known to dye men as Hessian Purple N Extra, or more simply, Direct Purple.

Whether he tried to buy it out of a dye catalog and failed, he doesn't say. At any rate, he made some by tetraazotizing *4,4'-Diaminostilbene-2,2'-disulfonic Acid* (Eastman T 4613) and coupling with *2-Naphthylamine* (Eastman 174) to get his indicator:



This starts from a deep red, shows a first transition at pH 4.0 to a faint mauve, turns emphatically purple at pH 3.8—a long sight more emphatically than methyl orange ever did—and finally goes over to a bluish purple at pH 3.0. Such behavior is reported a lot more useful for the acid titration of sodium carbonate than even that of our *Methyl Orange-Xylene Cyanole Solution* (Eastman A 2216), which was developed back in 1922. We saw our duty clearly before us to spare analysts from doing their own tetraazotizing and coupling. Thus Eastman 7000. It's used as a 0.1% solution.

Is Eastman 7000 *of special importance to us? No more so than the rest of the some 3500 organic chemicals we stock. They're all cataloged in our List No. 39, which you may have by writing to Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).*

Talking with film

There is a man in your trading area who calls himself an audio-visual dealer. This mid-20th-century addition to the roster of trades is a merchant of various devices for captivating a captive audience into granting access for your message to their minds through their eyes and ears. Assuming you have a message—most successful people nowadays have one—we point here to a new

and advanced example of one of the basic devices which your audio-visual man has for conveying it, the *Kodaslide Signet 500 Projector, Filmstrip Model.*

First we ask you to grant that the smoother the mechanical aspects of your presentation, the less likely it is to distract your audience from your subject matter. Therefore we have proceeded on the assumption that the pictures should follow each other instantaneously, quietly, positively, without jumping, without jerking. Instead of holding a lot of engineering conferences on how to accomplish this without resorting to a costly Geneva movement, we went ahead and actually used the Geneva movement and then made the engineers figure out how they could still keep the selling price down to $98.

And, since the customers were to be asked to lay their dough out for a projector, not just a Geneva movement, we had to insist on 1) sufficient brilliance and evenness of illumination to dispense with room darkening in most cases; 2) safeguarding the filmstrip by automatic separation of the glass pressure plates before it can move; 3) fast setup by virtue of drop-in loading for immediate sprocket engagement, a quick framing lever, and a quick rewind device; 4) cool operation of a 500-w lamp with little or no blower noise and no danger of burning a hole in the film; 5) automatic leveling capable of compensating for unevenness of support.

All this they did, our engineers, muttering all the while that sales people are unreasonable; for they knew all along that not only were they expected to come up with a world-beater of a filmstrip machine but also that the $98 package had to include a mechanism that the user could easily insert when he had Kodachrome slides to show!

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SLEEPING ACCOMMODATIONS AT 121st AAAS MEETING

Berkeley, California, December 26-31, 1954

The hotel, motel, and dormitory sleeping accommodations—their rates and the application coupon below—are for your convenience in making room reservations in Berkeley. Please send your application *directly* to the AAAS Housing Bureau and thereby avoid delay and confusion. The experienced Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less. **Single rooms may become scarce; double rooms for single occupancy cost more; if possible, share a twin-bedded room with a colleague—and also save.** Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival and also probable date of departure.

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Durant	4.00– 7.00	6.00– 9.00	6.50–10.00	10.00–16.00
Shattuck	5.00–10.00	7.00–10.00	7.50–10.00	10.00–18.00
Other hotels	3.00– 5.00	3.50– 5.00	4.00– 6.50	7.00–10.00

(Note: Most hotels have singles without private bath at $2.00–$3.50 per night)

MOTELS				FAMILY ROOMS
Berkeley Plaza	5.00	6.00	7.00	8.50–12.00
California	4.00– 4.50	4.50– 5.00	5.50	6.00– 7.00
Golden Bear	4.50– 5.00	5.00– 7.00	6.00– 8.00	7.50–10.00
Other motels	4.00– 5.00	4.00– 6.00	5.50– 8.50	6.00–12.00

Dormitory Accommodations: NOTE: The 766 units in the University of California dormitories are **primarily for students, younger faculty members, and those not on expense accounts.** Occupancy, two persons per room; rate, $2.00 the first night, $1.00 per night thereafter, per person.

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(State name of hotel, motel, or other)

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..... Double-bedded Room — Desired Rate ..... Maximum Rate .....
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HOTEL AND MOTEL ROOM DEPOSIT

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(These must be indicated—add approximate hour, a.m. or p.m.)

NAME .....
(Individual requesting reservation) (please print or type)

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(Street) (City and Zone) (State)

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2–8. Indian Science Congress Assoc., 42nd, Baroda, (ISCA, 1 Park St., Calcutta 16.)

11–14. American College of Surgeons, Inter-American session, Lima, Peru. (M. L. Mason, 40 E. Erie St., Chicago 11, Ill.)

11–14. Highway Research Board, Washington, D.C. (HRB, National Research Council, 2101 Constitution Ave., Washington 25.)

12. Astronomical Soc. of the Pacific, annual, San Francisco, Calif. (S. Einarsson, Leuschner Observatory, Univ. of California, Berkeley.)

12–15. World Symposium on Applied Solar Energy, Phoenix, Ariz. (M. L. Kastens, Stanford Research Inst., Stanford, Calif.)

13. American Genetic Assoc., annual business, Washington, D.C. (R. M. Cook, AGA, 1507 M St., NW, Washington.)

20–22. American Assoc. of Physics Teachers, New York, N.Y. (R. F. Paton, Dept. of Physics, Univ. of Illinois, Urbana.)

20–22. American Physical Soc., New York, N.Y. (K. K. Darrow, Columbia University, New York 27.)

21. Public Health Workshop on Dental Programs in Industry, 3rd, New York, N.Y. (A. J. Asgis, Hotel Statler, New York.)

24–27. American Soc. of Heating and Ventilating Engineers, Philadelphia, Pa. (A. V. Hutchinson, 62 Worth St., New York 13.)

26–2. Australian and New Zealand Assoc. for the Advancement of Science, Melbourne, Australia. (J. R. A. McMillan, 157 Gloucester St., Sydney.)

27. American Federation for Clinical Research, western section, Carmel, Calif. (A. B. French, College of Medicine, Univ. of Utah, Salt Lake City.)

28–29. Assoc. of Geology Teachers, annual, Columbus, O. (R. P. Goldthwait, Ohio State Univ., Columbus 10.)

28–29. Bur. of Biological Research, Rutgers Univ., New Brunswick, N.J. (W. H. Cole, College of Arts and Sciences, Rutgers Univ., New Brunswick.)

February

4–5. American Geophysical Union, Berkeley, Calif. (D. K. Todd, College of Engineering, Univ. of California, Berkeley 4.)

7–9. Conf. on Silicosis and Occupational Chest Diseases, Saranac Lake, N.Y. (N. R. Sturgis, Jr., Saranac Laboratory, Saranac Lake.)

7–11. American Soc. of Civil Engineers, San Diego, Calif. (W. N. Carey, 33 W. 39 St., New York 18.)

11–25. Pan American Acad. of General Practice, Lima, Peru. (A. Martinez, 54 E. 72 St., New York 21.)

13–17. American Inst. of Mining and Metallurgical Engineers, annual, Chicago, Ill. (E. H. Robie, 29 W. 39 St., New York 18.)

14–19. Latin American Cong. of Physical Medicine, Lima, Peru. (C. L. de Victoria, 176 E. 71 St., New York 21.)

17–18. National Conf. on Transitor Circuits, Philadelphia, Pa. (W. J. Popowski, Minneapolis-Honeywell Regulator Co., 176 W. Loudon St., Philadelphia 20.)

17–19. American Acad. of Forensic Sciences, Los Angeles, Calif. (W. J. R. Camp, 1853 Polk St., Chicago 12, Ill.)

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